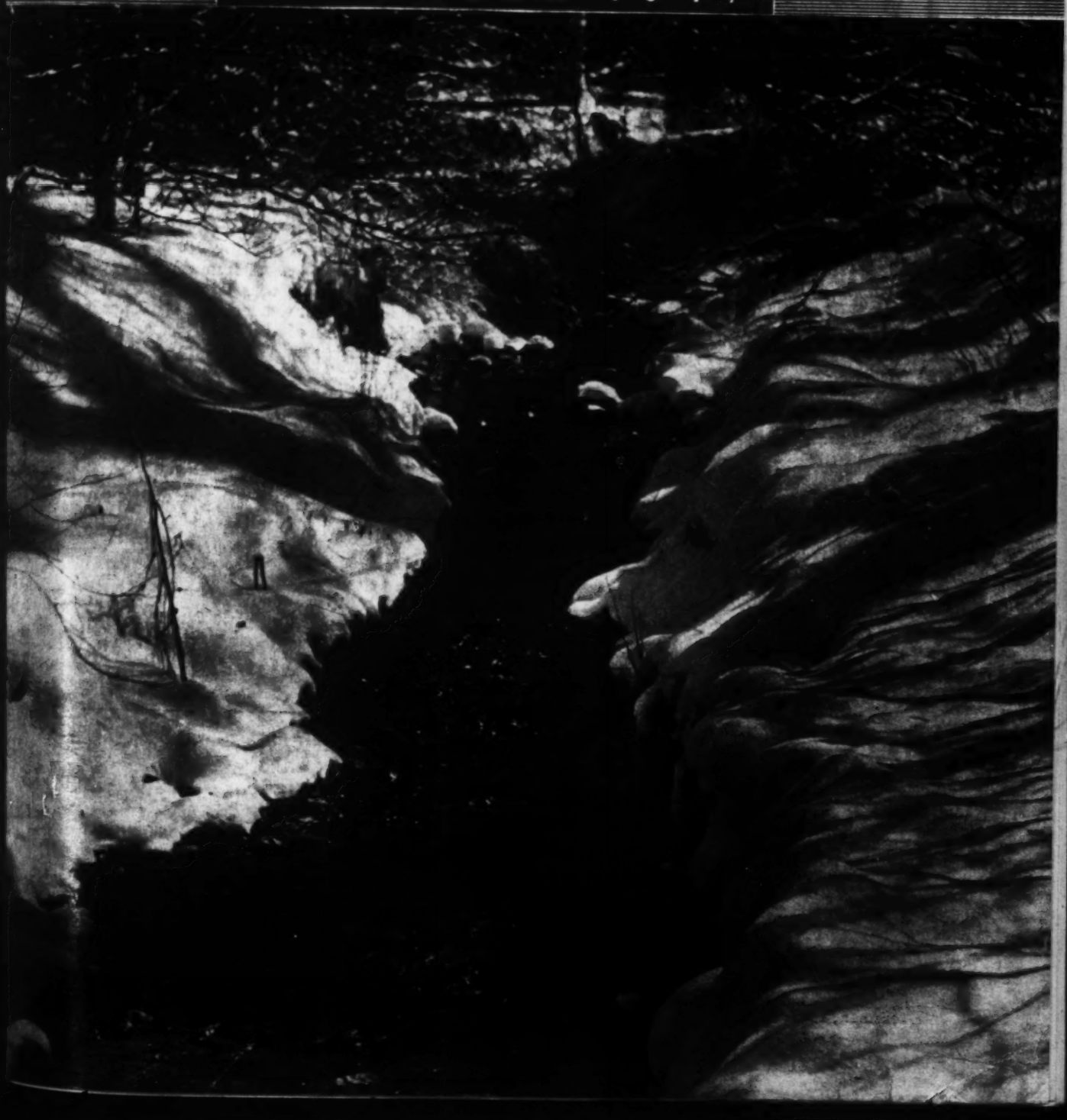
ENGINEERING
LIBRARY

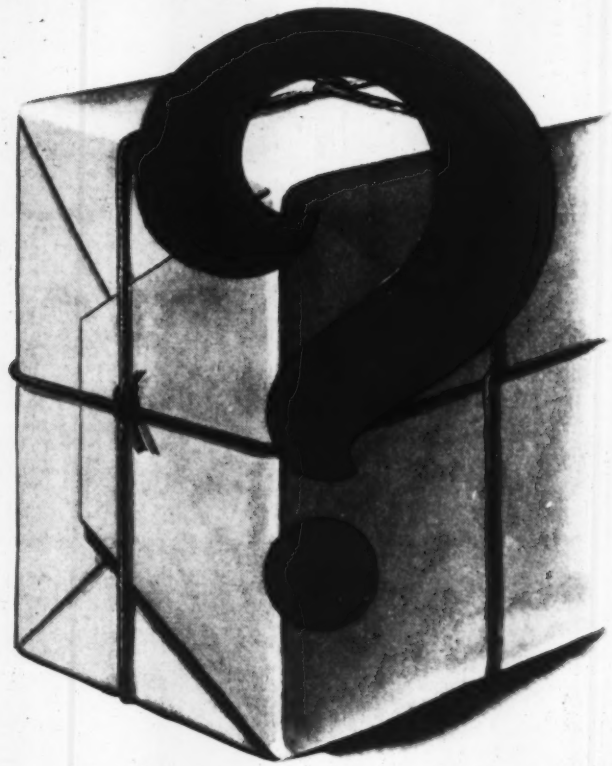
DEC 16 1947

MECHANICAL ENGINEERING

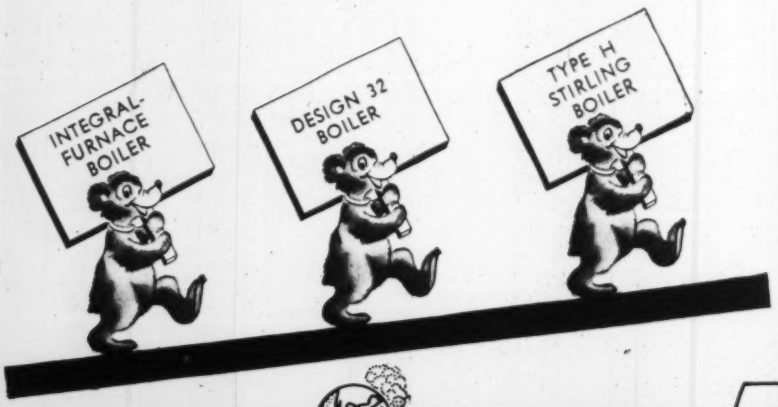
DECEMBER 1947



What is a package boiler?



From the definition given by POWER, a "packaged" steam-generating unit is completely self-contained, with firetube boiler, firing equipment, draft fans, feed pump, and automatic controls mounted on a single base, for shipment completely assembled and installed with a minimum of construction, usually requiring only steam, water, fuel, and electrical connections. It is designed as a unit, the various elements being coordinated to produce the desired results and the entire job is under a single responsibility. These units are satisfactorily meeting the conditions for which they are adapted. However, in the higher capacity ranges of 10,000 to 50,000 pounds and more of steam per hour and pressures above 160 psi design pressure, such a unit, in a complete sense of the word, is impracticable due to shipping and other limitations. B&W CUBS* are built for this service and offer as many of the desirable features of the "packaged" design and construction as are possible, all being compact, complete, and fully coordinated steam boiler units, built and installed under undivided responsibility.



* Complete Unit BoilerS

G-379

B&W

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: ALLIANCE AND BARBERTON, O.; AUGUSTA, GA.

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 69 NUMBER 12

Contents for December, 1947

THE COVER	*A Snow Scene. Courtesy of Edward S. Rowell*	
SYNTHETIC LIQUID FUELS IN THE UNITED STATES	*W. C. Schroeder*	989
PLASTICS IN AIRFRAME INTERIORS	*R. J. Considine*	996
INTEGRATED FOREST UTILIZATION IN THE PACIFIC NORTHWEST	*O. H. Schrader, Jr.*	999
AN APPROXIMATE FORMULA FOR PIPE FRICTION FACTORS	*L. F. Moody*	1005
CO-ORDINATING MATERIALS HANDLING WITH THE MANUFACTURING CYCLE	*S. C. Hoey*	1007
MATERIALS AND POWER	*Clyde Williams*	1012
STUDENT COUNSELING	*A. H. Morey*	1016
THE HABIT OF COMMUNITY SERVICE	*M. L. Cooke*	1017
PROFESSIONAL ADVANCEMENT IN CANADA	*C. R. Young*	1019
A REPORT TO THE COUNCIL OF E.C.P.D.	*J. W. Parker*	1021
E.C.P.D. FIFTEENTH ANNIVERSARY HELD IN MONTREAL, OCT. 24–25		1023
PERSONNEL ADMINISTRATION	*Alex Bavelas*	1025

EDITORIAL	987	REVIEWS OF BOOKS	1057
BRIEFING THE RECORD	1027	A.S.M.E. NEWS	1063
COMMENTS ON PAPERS	1047	A.S.M.E. JUNIOR FORUM	1071
A.S.M.E. BOILER CODE	1056	CONTENTS OF A.S.M.E. TRANSACTIONS	1088

INDEX TO ADVERTISING PAGES 108

OFFICERS OF THE SOCIETY:

EUGENE W. O'BRIEN, *President*

K. W. JAPPE, *Treasurer* C. E. DAVIES, *Secretary*

PUBLICATION STAFF:

GEORGE A. STETSON, *Editor* FREDERICK LASK, *Advertising Mgr.*

K. W. CLENDINNING, *Managing Editor*

PUBLICATIONS COMMITTEE:

L. N. ROWLEY, JR., *Chairman*

H. L. DRYDEN R. B. SMITH

J. M. JURAN JOHN HAYDOCK

ADVISORY MEMBERS OF THE COMMITTEE ON PUBLICATIONS:

N. C. EBAUGH, GAINESVILLE, FLA.

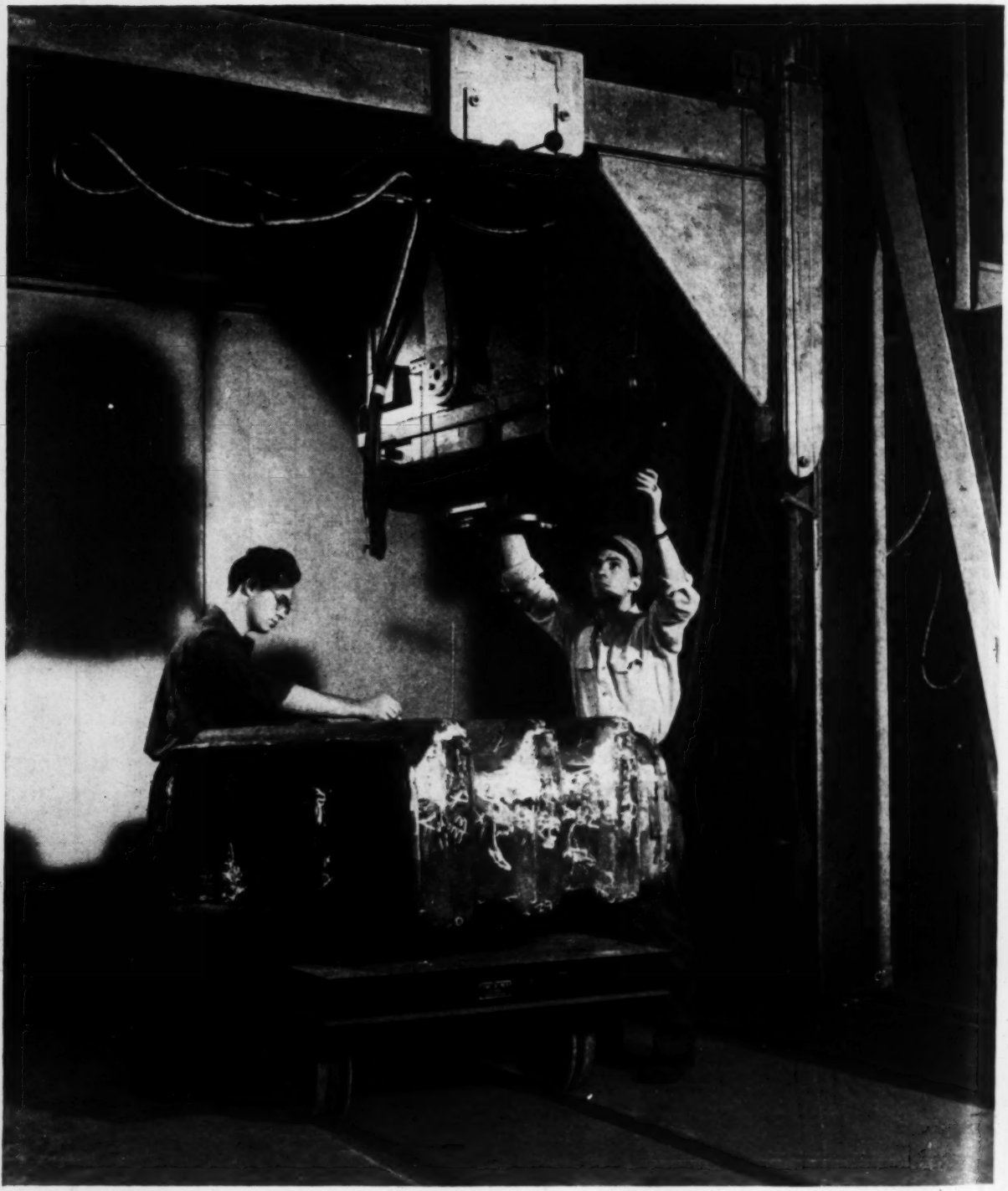
unior Members:

HUNTER R. HUGHES, JR., ATLANTA, GA.

LOUIS FELD, HARRISON, N. J.

JOHN H. PRENTISS, NEW YORK, N. Y.

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price 75 cents a copy, $6.00 a year; to members and affiliates, 50 cents a copy, $4.00 a year. Postage outside of the United States of America, $1.50 additional. Changes of address must be received at Society headquarters two weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921 . . . Copyrighted, 1947, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulations. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author, and that date of publication be stated.



Preparing a Thermalloy Casting for X-Ray Examination at Electro-Alloys Division of American Brake Shoe Company

MECHANICAL ENGINEERING

VOLUME 69
No. 12

DECEMBER
1947

GEORGE A. STETSON, *Editor*

W. E. Wickenden

WILLIAM E. WICKENDEN, whose death and official retirement as president of the Case School of Applied Science, now known as the Case Institute of Technology, occurred practically simultaneously last summer, made many and important contributions to engineering education and to the engineering profession. In addition to his work as an engineer, a teacher, and an administrator, he, with H. P. Hammond, played a conspicuous part in the extensive studies of engineering education which were so potently effective in setting its pattern in the interwar years. As president of the American Institute of Electrical Engineers, of the Society for the Promotion of Engineering Education, now the American Society for Engineering Education, as representative on the Engineers' Council for Professional Development, and in many other official and unofficial capacities he was continuously developing and enunciating educational and professional ideals and philosophies. Blest with extraordinary talents in effective speech and lucid forceful writing, his addresses and articles commanded respectful attention throughout the nation, and he was always in demand to deliver a speech or write a report or paper for the benefit of his colleagues. A considerable portion of the ideas and phraseology of the two notable reports of the S.P.E.E., "The Aims and Scope of Engineering Curricula," which appeared in 1940, and "Engineering Education After the War," published in 1944, was undoubtedly his. At the time of his death he had finished the first draft of a manual for young engineers, a volume, which others will have to put in form for publication, that will be issued by E.C.P.D. for the aid and guidance of youthful engineering graduates.

Few if any of the contributions by engineers which give expression to the spirit of public service which animates the engineering profession at its best have been read with approval by more persons than Wickenden's "The Second Mile," an address in which he shows that professionalism in engineering lays on its practitioners the obligation of rendering more service than duty demands. To quote his own comments on this remarkable address:

"One of the most suggestive verses in the Bible is this: 'If a man compel thee to go one mile, go with him twain.' This text is obviously a counsel of perfection, foolish if taken literally, but emphasizing a profound truth by its apparent denial of common sense. What it means is that many of life's experiences begin with a mile of compulsion but that its true freedom and durable rewards are to be won only in the mile of striving which lies beyond. In the first mile men must work to live; in the second they work to maintain their sense of dignity and worth. In the first mile they seek tangible rewards; in the second they strive for enduring satisfactions. In the first mile they seek pleasure; in the second, they discover happiness. The first mile is the mile of discipline; the second is the mile of freedom."

In the year in which he died Wickenden published another notable paper, "Shall Higher Education Be Expanded in the Technological Pattern?" (*The Journal of Education*, Vol. 1, No. 3, 1947) in which he discussed on general lines the relation which the technological curriculum bears to general education. In an era such as the present when educators are revising their concepts of general education, when it is being argued that the function of education is to develop the whole man (as E. W. Sinnott of the Sheffield Scientific School put it recently—the spirit of man as well as the mind of man), when the entire world is conscious of the fact that science has outstripped the intelligence of man as a social and economic being to make best use of its fruits without the destruction of society itself, it is important that the contributions of every form of educational method and principle be examined in an effort to determine what are their most progressive influences. In the article referred to, Wickenden reviewed briefly some of the means and objectives voiced by leaders in developing general education and stated the case in these areas of what he termed higher education on the technological pattern. Because it is likely that few engineers have read Wickenden's article in its original publication, certain portions of it are quoted here.

"Real freedom," wrote Wickenden, "is not a birthright; it is something you have to win the hard way. . . . No man's education is even well begun until he can do something extremely well. It does not matter so much what—type a letter, bake a pie, weld a seam, paint a house, do a portrait, beat a drum, compose a symphony, operate a radar, or design a Boulder Dam. What counts is the self-mastery that enables a man to look the world in the eye with steady self-assurance.

"The adequacy of any educational plan or system must be weighed in the scale of citizenship, no less than that of personal self-mastery, of career fitness, of cultural orientation, and of social and group morality. Engineers and scientists have had their share in the universal searching of educational consciences over our failure as a people before Pearl Harbor to discern the course of world affairs, to appraise aright the issues implicit in totalitarianism, to foresee the impending collapse of political and economic colonialism, and to get the

problems of race and color into true perspective. They share the common concern of the hour to find the middle path of wisdom in our domestic economy between the extremes of individualism and parasitism. . . .

"As all reasonable men recognize, these shortcomings have been universal. The products of our most liberal disciplines have been no more proof against them than those of our most technical disciplines, nor are the measures taken or proposed by one technologist for world security and co-operation overshadowed by any offered by the purest of our humanistic thinkers. . . ."

After pointing out that in many areas of professional citizenship and in those of participation in cultural life the engineer's is a "sustaining rather than a creating role," and a statement to the effect that only about one actively employed person in sixteen is engaged in what the census classifies as a profession," Wickenden showed that nonprofessionally educated persons go into "the general activities of business, industry, agriculture, and homemaking and into various semiprofessional service occupations. . . ."

"The historic aims and patterns of the arts colleges still have their place in this emerging picture," he stated, and continued:

"Against these traditional patterns let us set up for comparison a type of education which has the following characteristics:

"1 It is functionally related to a fairly broad area of economic activity.

"2 It is integral in structure, with continuous bands of general humanistic studies running lengthwise throughout the curriculum.

"3 It is of individually adjustable length, running through the entire range of undergraduate and postgraduate study.

"4 It provides for progressively increasing specialization, beginning with little or none and dividing by successive steps into branches which cover broad area occupations . . ., then specific professions or occupations . . ., then advanced specialties within such occupations. . . .

"5 It shares the ethical standards of a great professional body.

"6 It is highly motivated throughout, is strong in disciplinary features, calls for considerable intensity of application, and affords sufficient scope for both individual discipleship and independent effort."

It would be gratifying to engineers and to engineering educators if the foregoing characteristics were fully exemplified in all engineering curricula and in all institutions. But, as Wickenden pointed out, they are not. "The range from the best to the worst is very wide. It can be said, however," he added, "that the ideal so expressed is being increasingly realized, especially in the interrelation of humanistic, scientific, and technical studies." Yet, as he stated at the end of the article: "If the great expansion of higher education predicted for the next decade is actually realized, it seems likely that much more of it will follow the mode established in engineering, at least in its general plan and outline, than the older traditions of the liberal arts."

The death of an able thinker and writer like Dr. Wickenden is a great loss to engineering. Fortunately, he has left behind him in articles like those mentioned here, clearly expressed ideals and principles, and during his lifetime he inspired many other men whose "second mile" will lie along the road which leads to the fulfillment of the objectives toward which he himself had made great progress.

A.S.M.E. Publication Plan

MEMBERS of A.S.M.E. will be interested in the results of the letter ballots on the new publication plan which were counted on November 12. Of the 8095 ballots cast, 8037 were valid, and 723 were unmarked, leaving 6477 favorable to the plan and 837 opposed. The number of ballots cast was greater than usual on such occasions and the acceptance of the plan by a ratio of almost 8 to 1 provides a clear mandate to put it into effect on the first of the year. It will be the task of the Board on Technology, the Publications Committee, and the editorial staff to make the shift from the present to the new plan as quickly and as smoothly as possible, and to perfect details of operation and services with a view to reducing costs and inconvenience to members to a minimum.

In addition to the formal ballots, approximately 30 letters commenting on the plan were received from members. Approval of the plan was voiced in three of these letters, and various degrees of disapproval in the others. Objections raised in these letters were largely based on the extra expense incurred under the new plan by members who desire a considerable number, or all, of the Society's publications and on the inconvenience of ordering and paying for individual copies of papers. Several members made extremely helpful suggestions. Emphasis on quality, rather than quantity, of papers was called for in a number of cases. Long before the ballots were counted the Publications Committee began a study of all criticisms and suggestions. Some of the hardships imposed by the original plan may be lessened by the time it goes into effect, and as experience with its operation is gained, the Publications Committee will recommend other modifications wherever possible.

The feature of the new plan which should be most valuable to all readers of MECHANICAL ENGINEERING is the institution of the new department, "A.S.M.E. Technical Digests," in which it is planned to give the essence of every paper presented at national meetings and division conferences for which a manuscript is available (unless, of course, the paper is printed in full in MECHANICAL ENGINEERING). Never before has the journal of the Society been able to present such a service. Upward of 450 papers are presented at meetings every year, for which funds have been available for the publication of no more than half. Of those published, less than half have appeared in MECHANICAL ENGINEERING. While the new service offers only digests of meeting papers, whenever a digest is published a copy of the complete paper will be available and may be purchased at a nominal price.

SYNTHETIC LIQUID FUELS *in the* UNITED STATES[1]

By W. C. SCHROEDER

CHIEF, OFFICE OF SYNTHETIC LIQUID FUELS, BUREAU OF MINES. MEMBER A.S.M.E.

THE disappearance of the reserve capacity to produce natural crude oil in the United States is the most important difference between the country's prewar and postwar economic and security situation. Prior to the war, a reserve of 20 to 21 billion barrels would have permitted domestic production of about 5 million barrels daily at the maximum efficient rate, while actual production was less than 4 million barrels. In essence, there was a cushion of 1 million barrels a day to soak up the heavy war demand and to provide time in which the civilian consumption could be curtailed to provide still greater supplies for military uses.

Now a domestic crude production near 5,100,000 barrels daily is barely sufficient to meet the country's needs. It is also most probable that demand will continue to rise, for over 90 per cent of the locomotives on order are Diesel engines, domestic-oil-burner sales are at the highest rate in the history of the industry, fewer automobiles are burning more gasoline than before the war with an estimated 4.5 million new ones produced this year, and a developing passenger and freight traffic in the air is requiring larger volumes of high-octane gasoline. A predicted consumption requiring 6 million barrels of petroleum products a day by 1951 may err on the low side.

Today the country is still meeting its oil demands from a known reserve of 21 billion barrels plus a small net import of crude oil and petroleum products, but it is evident that domestic reserves must soon be increased or new sources of supply found. The prospects for increasing reserves in the United States are not bright, and the maintenance of the 21 billion barrel reserve has only been possible through extensions and revisions of previous estimates on known fields.

The reserve and exploration picture has become increasingly disquieting because discoveries of new oil pools have now failed to match consumption for 8 or 9 years while at the same time consumption is mounting rapidly.

On the other hand, the question is not, Can the United States find new sources of oil? but rather, What sources should be used?

SOURCES FOR OIL

Exploratory effort will undoubtedly find billions of barrels of oil, and this work should be carried forward vigorously. Deeper horizons, as well as drilling on the continental shelf, should help to maintain the oil reserves. Secondary recovery, that is, the attempt to rework old fields which have been exhausted by the ordinary pumping methods, is assuming greater importance. In some oil sand it is estimated that 30 to 50 per cent of the original oil may still be unrecovered. How far this work will go will depend to a considerable extent on the cost of recovering oil by these methods, as compared to the cost of producing it from other sources. It is estimated that postwar costs for discovering new oil are about three times prewar costs, in part the result of a generally higher price level but also because of greatly increased drilling and exploration work necessary to find the oil.

Importation of foreign oil is another possible source of large supplies. Until 1947, the United States has been a net exporter of petroleum and generally on a large scale. During the first 6 months of 1947 the country has shown a small import balance. This may, and probably does, reflect the beginning of the change in location of the large bodies of the world's proved oil reserves.

If the assumption is made that the American petroleum industry can operate freely in the foreign fields and will not have to pay exorbitantly for concessions, taxes, or oil, it is the author's belief that oil can be imported at a lower cost than it can be produced synthetically in this country at this time. From some economic viewpoints, this might be the best means for meeting any shortages of crude oil which may occur in the United States.

On the other hand, foreign consumption of petroleum increased about 13 per cent for the year 1946, as compared to 1941, and it is evident that some of the world's so-called backward nations are awakening to the need for a mechanized economy to supply their large populations. Moreover, industrialized nations such as England and France are finding it difficult to meet their energy requirements from coal and are showing a definite tendency to turn to oil as the most practical substitute. If this trend continues and increases, the proportion of the world's oil available to the United States may tend to diminish markedly.

This discussion of imported oil has not so far considered the strategic aspect of foreign sources. Sea lanes along the coast of the United States were difficult to keep open in the late war even with well-organized land-based protection at hand. In spite of the effort to protect tankers, the shipment of oil became so critical that it forced rapid construction of the "Big-Inch" and "Little Big-Inch" pipe lines. It is not difficult to visualize the much greater problem that would be created by the long journey through open waters from the Persian Gulf area or even from South America.

In addition to the shipping problem, the oil industry and, under emergency or war conditions, the Government may be faced with the problem of preventing either the physical destruction of the foreign oil fields and their equipment or possible seizure. It is the author's belief that the United States, whose economic health and protection are so greatly dependent on oil, should never allow the security of a large proportion of its supply to rest in distant foreign lands.

SOURCES OF SYNTHETIC OILS

In a broad chemical sense, it is probable that most carbonaceous material could be used for the production of oil. Practically, however, since huge volumes of raw material must be available at low cost near the synthetic-oil plants, the choice is

[1] Published by permission of the Director, Bureau of Mines, Department of the Interior, Washington, D. C.

Contributed by the Fuels Division and presented at the Annual Meeting, Atlantic City, N. J., December 1–5, 1947, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

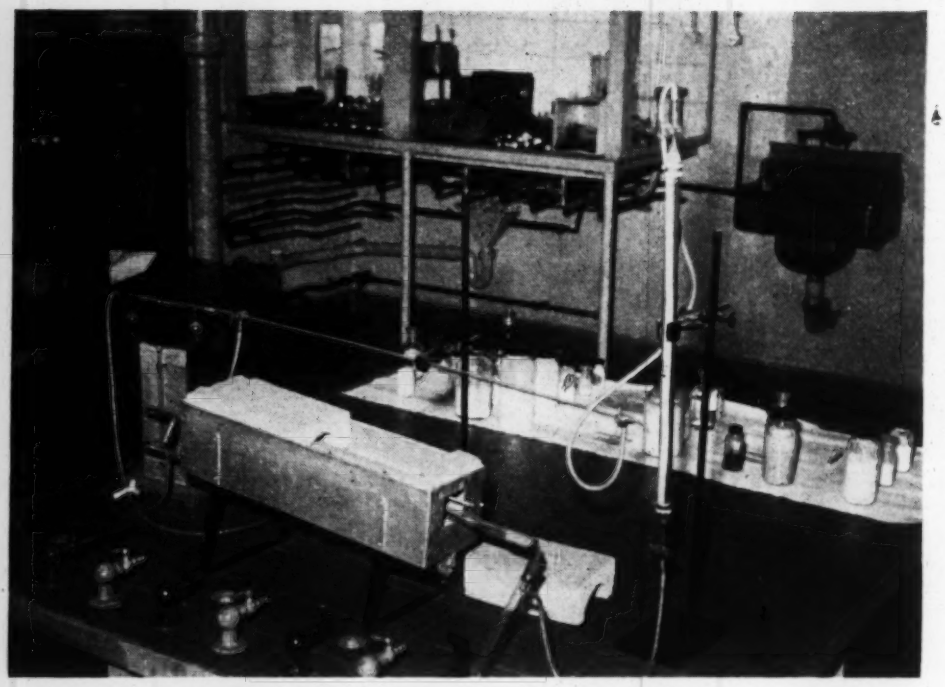


FIG. 1 ORIGINAL FISCHER-TROPSCH APPARATUS

limited to natural gas, oil shale, and coal, and in some circumstances possibly agricultural wastes.

To establish a synthetic-fuel industry furnishing a considerable fraction of this country's oil needs will impose heavy demands on these raw materials, and the choice of the ones to be used will be determined by at least four major factors, as follows:

1 Raw material available.
2 Water supply.
3 Predominant type of products wanted, i.e., fuel oil, Diesel oil, or gasoline.
4 Location of market and transportation costs for products.

The significance of these factors is related to the synthetic-oil processes used and will be pointed out under consideration of the individual processes.

FISCHER-TROPSCH PROCESS USING NATURAL GAS

Fischer-Tropsch Catalyst Chambers. The Fischer-Tropsch process has in recent years been designated by a number of names, depending to some extent on the engineering features by which the reactions were accomplished on a large scale. The basic chemistry is still the reaction investigated by Fischer and Tropsch in which carbon monoxide reacts with hydrogen to eliminate water (or carbon dioxide) at the surface of a catalyst to form straight-chain or isoparaffins (and some unsaturated compounds) in the liquid range. Fig. 1 shows the original apparatus used by Fischer in the Kaiser Wilhelm Institute at Mulheim-Ruhr for a study of the Fischer-Tropsch reactions. With cobalt and thorium catalysts, the product was largely paraffinic in nature, containing about 10 per cent isocompounds, and ranged from a solid wax through Diesel fuel and gasoline fractions to gases such as butane, propane, ethane, and methane. Iron catalysts tend to yield more wax and about the same amount of isocompounds.

The use of the Fischer-Tropsch process determines the type of products that can be made, although the selection of the catalyst and operating conditions can vary the product within limits. Since the cobalt catalysts give paraffinic compounds, a Diesel fuel of 100 cetane number can be produced while the gasoline is only about 45 octane. The iron catalyst gives a lower-cetane Diesel fuel, but gasoline of higher octane suitable for motor fuel. The process as now operated does not lend itself to the production of high-octane aviation gasoline with good rich-mixture performance.

To carry out the Fischer-Tropsch reactions on a laboratory scale is not difficult, but on a large scale the rapid removal of the heat of reaction (46,000 Btu per gal of oil formed) becomes difficult. In addition, the temperature at the catalyst surface must be controlled within a few degrees, for if it is too hot the production of methane grows at the expense of oil formation and the catalyst may be ruined, while too low a temperature slows down the process and gives excessive wax formation.

The German commercial plants in 1944 had catalyst chambers of complex construction, containing large amounts of steel to carry the heat of reaction to cooling water. Oil production per chamber was about 18 barrels a day, and a large number of chambers were necessary for a plant of reasonable size, as shown in Fig. 2. This equipment was expensive to build and operate.

Several new types of catalyst chambers are under development in this country. Two of these now give promise of commercial application. In one, which was largely developed in the oil industry, the synthesis gas is blown through the catalyst bed to keep it in a fluidized state, and the heat is removed by water-cooled surfaces in this fluid area. It is reported that high rates of throughput have been achieved, and that chambers producing several thousands of barrels of oil a day are possible.

The research laboratories of the Bureau of Mines have developed a chamber in which a cut of oil from the process is passed through the catalyst bed to carry away heat both by conduction and evaporation. Fig. 3 shows the pilot plant which has been used for this work. The flow of gas and oil is co-current. Space velocities of gas through the catalyst about 4 to 5 times the German rates have been achieved, and no material difficulty is foreseen in enlarging this chamber to a capacity of 500 bbl per day or more.

Synthesis Gas From Natural Gas. Natural gas is largely

methane, and to convert this to synthesis gas (carbon monoxide and hydrogen) two methods can be followed as shown

(1) $\underset{CH_4}{\text{Methane}} + \underset{H_2O}{\text{Water}} \rightarrow \underset{CO}{\text{Carbon monoxide}} + \underset{3\,H_2}{\text{Hydrogen}}$

(1a) $CH_4 + \underset{CO_2}{\text{Carbon dioxide}} \rightarrow 2\,CO + 2\,H_2$

(1b) $2\,CH_4 + H_2O + CO_2 \rightarrow 3\,CO + 5\,H_2$

or

(2) $\underset{CH_4}{\text{Methane}} + \underset{{}^1/_2\,O_2}{\text{Oxygen}} \rightarrow \underset{CO}{\text{Carbon monoxide}} + \underset{2\,H_2}{\text{Hydrogen}}$

Reaction (1) is generally used in synthetic-ammonia plants to produce hydrogen. It is often carried out at about 900 C, by passing the mixture of natural gas and steam through tubes filled with a catalyst of nickel on aluminum oxide. For the Fischer-Tropsch process the gas is too rich in hydrogen, and one proposal for getting the proper ratio of hydrogen to carbon monoxide is to introduce carbon dioxide in the reacting mixture as in (1a), or carbon dioxide and water as in (1b). One carbon monoxide to 2 hydrogen is suitable for the cobalt catalyst, and 1 hydrogen to 1 carbon monoxide for the iron catalyst. These reactions are endothermic, and the heat comes from the combustion of natural gas on the outside of the tubes.

The second method for making synthesis gas from methane does not use an external supply of natural gas to provide heat but carries out a direct, partial combustion of gas with oxygen. The oxygen is obtained by low-temperature fractionation of air.

Which of these two methods will prove the most economical will depend upon the cost of the natural gas compared with the cost of oxygen. Oxygen has the added advantage, however, that production of the synthesis gas can be carried out under pressure, and its use affords an outlet for the large amount of low-pressure steam generated in the catalyst chamber which can be used to make power for the oxygen plant. If oxygen is not used, it would be necessary to find some extraneous outlet for the power resulting from the Fischer-Tropsch operations.

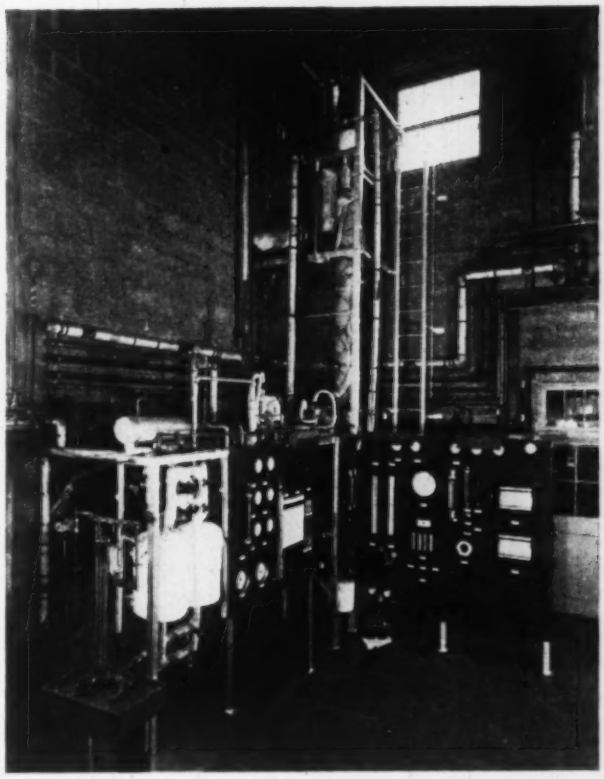


FIG. 3 BUREAU OF MINES INTERNALLY COOLED CONVERTER FOR FISCHER-TROPSCH SYNTHESIS

Location of Plants Using Natural Gas. To locate Fischer-Tropsch plants using natural gas, it is necessary first to determine the raw materials needed. A plant making 10,000 bbl per day of primary product is near the minimum that should be considered an economic unit. Since the initial investment in

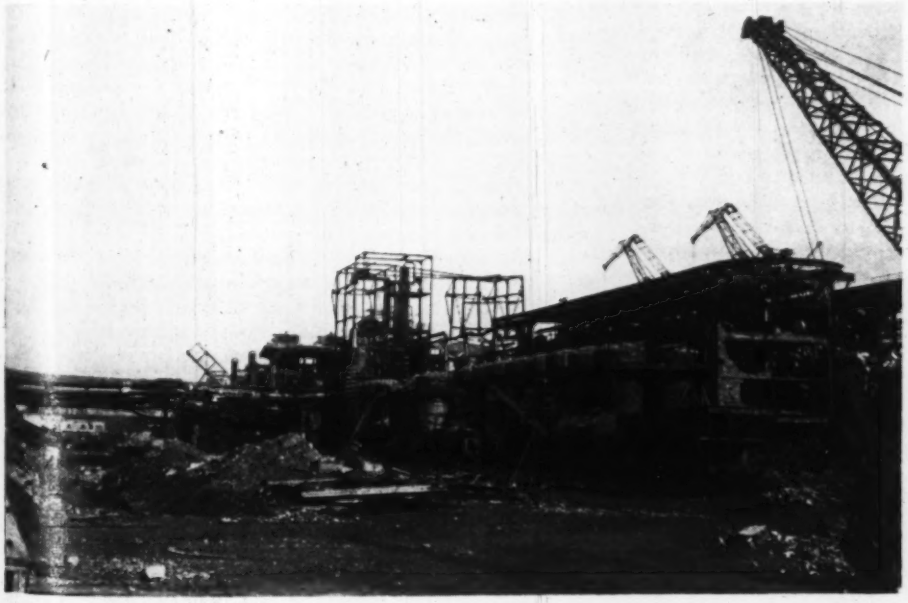


FIG. 2 BATTERY OF MIDDLE PRESSURE SYNTHESIS CHAMBERS IN GERMAN FISCHER-TROPSCH PLANT

the plant is high, it should be amortized over as long a period as possible, which in this case was assumed to be about 25 years. Then the requirements are as follows:

Gas	120 million cubic feet per day 43 billion cubic feet per year Approximately 1 trillion cubic feet over the life of the plant
Water	15 million gallons daily
Products	Wax and oil, Diesel oil, motor gasoline, and alcohols; total 10,000 barrels daily

These requirements are not easily met, since they call for a locality with 1 trillion cubic feet of gas exclusively for the plant, and ample supplies of cooling water. Table 1 indicates some of the major proved gas reserves in the United States.

TABLE 1 PROVED GAS RESERVES IN UNITED STATES

Location	Trillions of cubic feet (approx.)
Appalachian	5
Kansas	14
Oklahoma	11
Louisiana	22
Texas	86
California	11

Obviously, if all this gas were available for Fischer-Tropsch plants, many suitable locations could be found, but this is not the case. In the Appalachian field, it is used for industrial and domestic purposes, and the reserves in the main are scattered and do not offer good plant locations. In Kansas, Oklahoma, Louisiana, and California the reserves are concentrated, but they supply the huge natural-gas pipe lines, and the number of locations which could furnish a total of 1 trillion cubic feet to a Fischer-Tropsch plant is limited. In a state like Kansas, for example, it is probable that not more than a few 10,000 barrel-a-day Fischer-Tropsch plants could be located. The problem is further complicated because some areas which have sufficient natural gas would have difficulty in meeting the water requirements. This reasoning assumes, of course, that the gas going to the pipe lines will not or could not be greatly curtailed to meet large synthetic-liquid-fuel requirements.

Probably the greatest bulk of idle gas is in the Gulf Coast and southwest Texas. Proved reserves are approximately 40 trillion cubic feet, and at the present time pipe-line demand is relatively small. Locations near the coast, which will provide ample water for cooling, should meet the plant requirements. In this area, natural gasoline is recovered by condensate operations and about 50 per cent of the gas is returned to the well for repressuring. The Fischer-Tropsch plants could, however, be tied in with these condensate operations.[2]

Of the present proved reserves of natural gas as much as 30 to 50 trillion cubic feet might be available for conversion to liquid fuels. From 50 trillion cubic feet the total liquid product is estimated at 4 to 5 billion barrels. In this discussion no attempt has been made to estimate the effect of new discoveries which can add materially to the gas available for industrial use as well as for liquid fuels.

FISCHER-TROPSCH PLANTS USING COAL

The carbon monoxide and hydrogen used for the Fischer-Tropsch synthesis can be made from coal as well as from natural gas. The usual method for making these gases, and the one used in all the commercial Fischer-Tropsch plants in Germany, was to make coke from coal and then gasify the coke in water-gas machines. That process could be used in the United States, but it has very serious disadvantages. Two of the most important are that the initial investment in the combined coke-oven water-gas equipment is very high and the coal must all be of coking quality. This last requirement would eliminate many of the largest and thickest beds of coal in the United States, especially in the west, from use in the Fischer-Tropsch process. At the same time, it could throw a very large demand for fuel on the relatively limited reserves of good coking coal. From both a conservation and cost standpoint, it seems essential to devise a gasification process which does not depend on coking coal.

Gasification of noncoking coal with oxygen and steam, either in the pulverized or coarse state, is possible and may offer the solution to the gasification problem. This would be particularly true if the gasification were conducted under pressure, and the synthesis gas delivered directly to the Fischer-Tropsch plant without further compression. The volume of oxygen to be compressed is much less than the volume of synthesis gas, and the steam could be supplied under the necessary boiler pressure.

The Lurgi gasification process does operate under pressure, but as used up to the present time requires a sized fuel and produces considerable quantities of methane. If the temperature of the entire fuel bed were increased materially, the methane concentration could be reduced, but this probably means either a fluidized bed or pulverized fuel. In the latter cases, the operating temperature through the fuel zone would be fairly uniform and could be held at a level that would give high concentrations of carbon monoxide and hydrogen. The investment in an oxygen plant is large, and production costs, even excluding the cost of power available from the Fischer-Tropsch process, are still relatively high. The prime function of the oxygen in the process is to furnish heat to maintain the high reaction temperature through combustion of some of the coal. The oxygen needed can be reduced or eliminated by highly superheating the gases and steam going to the reacting zone.

At this point, the possibilities of underground gasification should not be overlooked even though it is true that considerable development work remains to be done. Fig. 4 shows tunneling operations for underground gasification at Gorgas, Ala. From this experiment[3] it was found that this process can utilize a high percentage of the coal. With oxygen, and particularly if the whole operation can be conducted under pressure, it should not be difficult to secure very high temperatures and a gas suitable for synthesis purposes. At the same time, it is evident that each coal bed will present its own problems and require specialized development work.

The whole gasification problem is under intensive investigation both by industry and by the Bureau of Mines, and it seems reasonably certain that within the next year major improvements in the gasification processes can be expected.

About 35,000 cu ft of water gas is needed to make a barrel of Fischer-Tropsch oil. Even on the basis of the best methods now available, very few gasification engineers are ready to talk costs below 10 cents per 1000 cu ft of synthesis gas, assuming a good grade of coal at $2 a ton. This means that the gas to the Fischer-Tropsch process for a barrel of oil will cost about $3.50. To this must be added the Fischer-Tropsch processing costs which will be small compared to the cost of gas

[2] While this discussion is concerned with natural gas in the United States, it is interesting to observe that gas reserves in other countries might supply considerable amounts of synthetic fuels. For example, the latest available (May, 1947) report of the Ministry of Fomento shows near 1 billion cubic feet of natural gas daily discharged to the atmosphere in the Venezuelan oil fields. This amounted to approximately 400 million in the Maracaibo District; 300 million in the Maturin District; and around 230 million in the Barcelona District.

[3] Conducted jointly by the Alabama Power Company and the Bureau of Mines.

FIG. 4 TUNNELING FOR UNDERGROUND GASIFICATION WORK AT GORGAS, ALA., CO-OPERATIVE PROJECT CONDUCTED BY ALABAMA POWER COMPANY AND THE BUREAU OF MINES

production. At the present time, it would appear that substantial reduction in the cost of Fischer-Tropsch oil is going to depend upon producing synthesis gas at low cost. Before leaving this subject, however, it should be noted that Fischer-Tropsch primary product is a high-grade oil and can be refined to useful products with negligible losses.

The raw materials required for a 10,000-barrel-a-day Fischer-Tropsch plant using coal are approximately as follows:

Coal, tons per day (about 12,000 to 13,000-Btu)	6500
Coal, tons per year (about 12,000 to 13,000-Btu)	2 4 million
Coal, tons, for an assumed plant life of 25 yr	60 million
Water, gal per day	15 million
Synthesis gas, cu ft per day	350 million

Assuming a coal bed about 8 ft thick, approximately 10 square miles would be needed over the plant life. More than 20 states with good coal reserves would offer numerous sites for such plants. In order to minimize transportation cost for coal and water, it would be desirable to have sites at which both materials are readily available, and such sites will be limited. In the east, the water problem will not be as difficult as in many of the western states. The question of plant location with respect to markets is one that will be decided by the cost of coal versus the cost of transportation of oil and gasoline. Many of the eastern coal fields are near large markets but mining is relatively expensive, while in the west coal is available in thicker beds, often at low cost, but the product will have to be shipped to the point of use. At the present time, sufficient information is at hand to estimate for a given set of circumstances the most economical arrangement.

COAL HYDROGENATION

The broad features of the chemistry of the coal-hydrogenation process are known, although a thorough understanding of the individual reactions and the conditions that affect them still remains to be worked out. To make a liquid product by hydrogenation, the coal is mixed with heavy oil from the process, the mixture is heated to about 450 C and hydrogen gas introduced under pressure in the presence of a catalyst. It is now known that the coal dissolves in the oil (such solution is possible in coal-tar fractions or hydrogenated coal-tar fraction) or at least depolymerizes to the extent that the very large molecules are broken down and are present in the liquid in an unsaturated and very reactive state. If hydrogen gas is immediately available, it enters the molecular structure to produce a stable oil-like material. If hydrogen is not available, the reactive molecular groups tend to repolymerize and form asphaltic material which is exceedingly difficult to liquefy by subsequent treatment. The function of the catalyst, which is generally tin oxide or iron sulphate, depending on the pressure, seems to be to promote the reaction of hydrogen with the liquid medium which in turn gives up hydrogen to the newly formed molecular groups.

The complete flow diagram and equipment for the hydrogenation process are extremely complex. Since the process operates at pressures from 3000 to 10,000 psi, a considerable number of highly specialized engineering problems are met. Bureau of Mines laboratories for a broad-scale investigation of the coal-hydrogenation and Fischer-Tropsch process are shown in Fig. 5.

The hydrogenation process is well adapted to the production of aviation gasoline from coal and, in fact, is the only large-scale synthetic process at present which will give a base stock for 100-octane gasoline with good rich-mixture performance. It does not produce as good a Diesel fuel and at this time it probably will not produce motor gasoline as cheaply as the Fischer-Tropsch process. In addition, a light hydrogenation of coal at low pressure may offer a good synthetic process for the production of fuel oil.

It is estimated that the cost of producing and compressing hydrogen is 50 per cent of the total cost of producing gasoline by the hydrogenation process. Improvements in the production of synthesis gas for the Fischer-Tropsch process are also improvements for the hydrogenation process, since the carbon-monoxide portion of the synthesis gas can readily be reacted catalytically with steam to give hydrogen.

Because the cost of compressed hydrogen is about one half

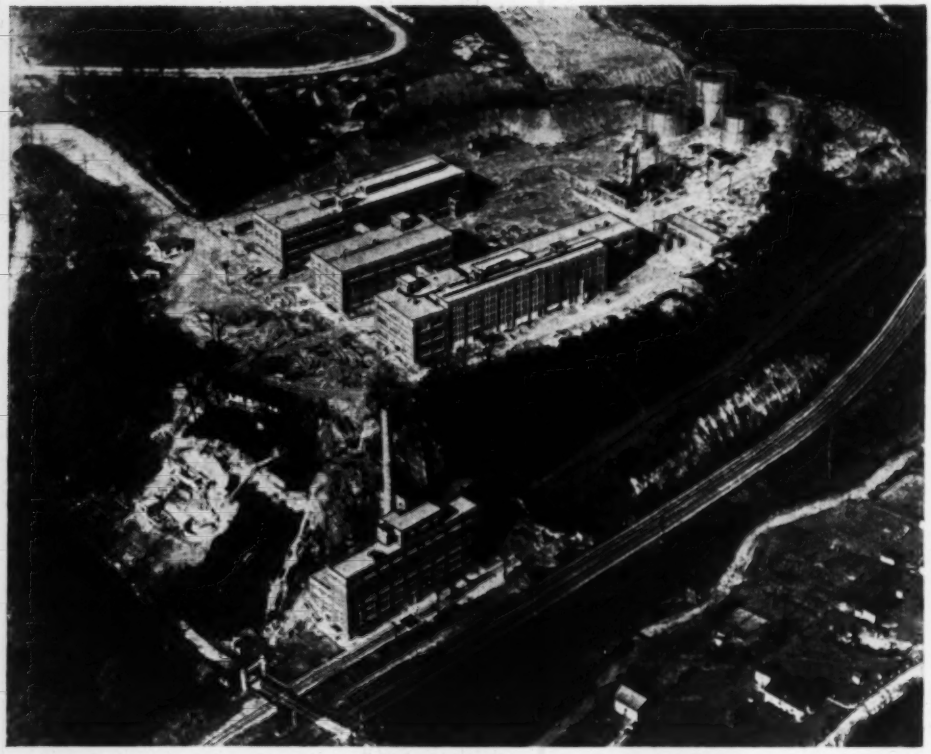


FIG. 5 BUREAU OF MINES LABORATORIES FOR INVESTIGATION OF COAL HYDROGENATION AND FISCHER-TROPSCH PROCESSES

the total cost of gasoline, it is important to consider the use of natural gas as a source for hydrogen. Natural gas at 5 cents would give hydrogen at about one third the cost of obtaining it from coal at $2 a ton, and would result in a material saving both in the plant investment and operating cost of a hydrogenation plant. This possibility depends, of course, upon having natural gas near or piping it to a coal field. In certain areas of Wyoming, Illinois, and Texas, natural gas and coal could be secured for such operations.

The amount of gas needed is not large compared to the liquid product. Assuming that the hydrocarbon gas from the converters is used to make as much hydrogen as possible, the amount of natural gas would be approximately 6 to 8 per cent of the product on a weight basis. This would have the effect of making large amounts of liquid product available from a small amount of natural gas. The possibilities from both the economic and conservation viewpoints of a hydrogenation process using natural gas to furnish hydrogen are sufficiently attractive to justify a thorough analysis which is now being made by the Bureau of Mines.

The minimum-size commercial hydrogenation plant for the United States is about 30,000 barrels a day, and the following estimate for raw material is based on such a plant:

Coal, tons per day (about 12000–13000 Btu)	17,000
Coal, tons per year (about 12000–13000 Btu)	6.12 million
Coal, tons, for assumed plant life of 25 years	153 million
About 30 sq miles of 8-ft coal needed over plant life	
Water, gal per day	50 million

The location of these plants offers much the same problems as those encountered for Fischer-Tropsch plants operating on coal.

OIL-SHALE PLANT

Since oil shale of reasonably good grade contains 10 to 50 per cent carbonaceous material from which oil can be produced, it might seem uneconomic to mine this material for the production of oil in comparison with coal which contains a high percentage of useful carbon. This reasoning does not take account of certain basic advantages which oil shale possesses. The first of these is the occurrence of the shale in essentially horizontal strata containing an average of about 30 gal of oil per ton of shale in a bed 70 to 100 ft thick in Colorado and extending in almost continuous but thinning beds into Utah and Wyoming. Mining costs under these conditions are of a different order of magnitude from those encountered in mining underground coal beds $^1/_{10}$ or $^1/_{20}$ of this thickness. The second advantage is that the processing of oil shale is relatively simple, costing less for initial investment and plant operation than coal.

The effect of differences in processing is reflected in still another way. Assuming coal contains 90 per cent carbonaceous material and shale only 18 (about 30 gal of oil per ton), it might be expected that it would require 5 times as much shale as coal to make a barrel of oil. Instead, 1.5 tons of shale will make a barrel of oil, while 0.65 tons of coal are required for a barrel of oil. The ratio then is not 5 tons of shale to 1 ton of coal but 2.3 tons of shale to 1 ton of coal. The large amount of coal is required to furnish heat and energy to the coal process which is not needed in shale processing. With mining costs $^1/_4$ to $^1/_3$ of those for coal, it is apparent that oil shale is a suitable source of raw material for synthetic fuels.

The Bureau of Mines oil-shale plant, which is now in operation at Rifle, Col., is investigating on an extensive scale all phases of shale-oil production. Figs. 6 and 7 are views of some of the mine and plant areas.

The plan for economic studies of the mining is now fully developed and a large-scale mine to demonstrate operations at the rate of 5000 tons a day has been opened. A 70-ft shale bed is minable in 3 benches, and entryways are large enough to take a large electric or Diesel shovel underground. All operations such as drilling, blasting, loading, and transportation are

FIG. 6 SHALE BED, ROAD, AND ENTRANCES TO OIL-SHALE MINE AT BUREAU OF MINES OIL-SHALE PLANT, RIFLE, COLO.

predicated on the maximum degree of mechanization, and detailed economic studies indicate that production of about 40 to 50 tons of shale per man-day can be achieved. Under these circumstances, the shale will be mined for about 50 cents per ton.

Processing after mining involves crushing the shale and retorting (heating) to produce oil. The end product is an oil having a gravity of about 25 to 30 deg API depending upon the method of retorting.

On the basis of present knowledge, oil shale can be refined to yield industrial fuel oil and Diesel fuel with a cetane rating between 35 and 45. It cannot be looked upon as a good motor-fuel stock, for it yields a low-octane (about 50 or 60) gasoline. Shale oil differs materially from petroleum in that it contains considerable amounts of unsaturated or olefinic compounds. It cannot be refined into substitutes for petroleum products by the normal methods used on petroleum, and special methods must be developed. A light hydrogenation at 200 or 300 psi pressure has given very good results on Diesel fuel but disappointing results on motor fuel. The whole refining problem needs and is receiving intensive investigation. This work will be carried out by extensive co-operative tests with industry and special studies in Bureau of Mines laboratories.

The raw material needed for a 10,000-barrel-a-day oil-shale plant on the basis of processing the 70-ft bed in the Green River formation of Colorado is as follows:

Oil shale, tons per day	15,000
For 25-yr plant life about 2 sq miles of a 70-ft bed of shale	
Water, gal per day (with recirculation)	1.7 million

Since the oil-shale beds exist in enormous areas in three states and in smaller quantities in many others, the location of the necessary reserves for many plants will offer no difficulty. However, the shale is in mountainous terrain, frequently at elevations of 7000 to 8000 ft, and the plant sites must be selected with care. Although this process does not require a large amount of water, the richest shale reserves are in somewhat arid regions of the country, and the availability of the water will be one of the determining factors in plant location.

FIG. 7 PROCESSING SECTION, BUREAU OF MINES OIL-SHALE PLANT

SUMMARY

Since the passage of the Synthetic Liquid Fuels Act in 1944, it has become increasingly apparent that the United States will turn to synthetic sources to augment its petroleum resources. It is anticipated that costs at the plant will be from 3 to 5 cents a gallon higher than present prices of products from petroleum, although further reduction in synthetic costs may be achieved by process improvement and large-scale operation. The raw materials that will be used first are natural gas, oil shale, and coal. The raw material or processing method to be used will depend on the economics surrounding each plant installation, as well as the type of product desired, i.e., industrial fuel oil, Diesel fuel, or gasoline.

This paper has attempted to show the basic raw materials needed for the synthetic-fuel plants, and the major problems involved in site selections. The establishment of a synthetic-fuel industry to supply an appreciable fraction of the country's oil needs must be preceded by study to determine areas in which raw materials and water are available in adequate supply.

It is not desirable to delay the establishment of a synthetic-fuel industry until an emergency period. To build a capacity of 1 to 2 million barrels daily would require several years and large amounts of steel and other materials as well as manpower. This program would be about 5 to 10 times the magnitude of the synthetic-rubber program during the last war. It would be most desirable to avoid such a drain of national resources during an emergency.

PLASTICS *in* AIRFRAME INTERIORS

By R. J. CONSIDINE[1]

CHIEF ENGINEER, ARTISAN ENGINEERING AND MFG. CO., LOS ANGELES, CALIF.

ONE of the most important concepts of airframe design is weight. Should a designer find it possible to reduce the weight of a given aircraft structure and still retain adequate strength, then it would be possible for that airframe to carry more weight in useful pay load. Consequently, the airframe designers are on a never-ending quest for new materials with a higher and higher strength-to-weight ratio. So it is that in the evolution of airframe design, new materials are constantly being developed, studied, tested, and, if satisfactory, employed on the airplane. Therefore, in effect, we find that materials suitable for fabrication are evolving at approximately the same tempo as the airframe itself.

INCREASING USE OF PLASTICS IN AIRCRAFT

Plastic materials are no exception to this trend. They evolved from the first doping agents used in the early aircraft, through the development of the laminated and molded phenol formaldehydes used in electrical and nonstructural parts, through the development of the now well-known methyl methacrylates, and currently into the development of the versatile vinyl chlorides. The evolution has carried the plastics from the doping agents of early aircraft to the 300 and more applications of over 20 different plastic materials used on our present-day luxury transports, such as the Douglas DC-6.

While it is generally true that, during the periods of critical material shortages in the war and postwar years, plastics were used as substitute materials, many of these same plastic applications have now become permanent because of the excellent war-service records shown by the materials. Some plastics which had gained their entry via the critical-shortage route were able to hold their applications because of an observed weight saving coupled with an improved appearance. However, the fact must be stressed that in present airframe design, a plastic material, or any other material, is not employed unless it will fill its particular function as well as, or better than any other material known to the airframe designers.

Weight savings, strength-weight ratio, and appearance are not the only factors which are considered for plastic-material design. Impact strength, wear resistance, fire resistance, optical properties, dielectric properties, thermal properties, to mention only a few, may easily become the key or deciding factors of material selection. Many applications which have required some one of these properties have actually demonstrated a weight increase.

Thus, with all the considerations of present-day engineering imposed on the plastics, we find they have graduated from a group of novelty materials to a position among the engineered materials in modern construction.

For purposes of demonstration, a few problems which faced the interior designers will be reviewed to illustrate the procedure followed in the development of an application and in the selection of material for that application.

DESIGN PROBLEMS SOLVED WITH PLASTIC MATERIALS

One of the best examples of the complex problems which were solved with plastics is the window on the DC-6. The design requirements were as follows:

The window must withstand air loads and cabin pressurizing loads. The window must not fog or frost over at high altitude. The window must have good optical properties. The window must be tough enough to withstand the deflections of the airframe, the handling in the shop, and the handling in storage of the spare parts.

A research program was initiated and various optical materials were studied. The double-pane window was developed to prevent the fog and frost which normally forms on a single-pane window at high altitudes and obstructs the passengers' view. The application of the acrylics to the window design proved in test to be the material best able to withstand the air and pressurizing loads coupled with the impact strength required to withstand the handling. The acrylics also supplied the required optical clarity.

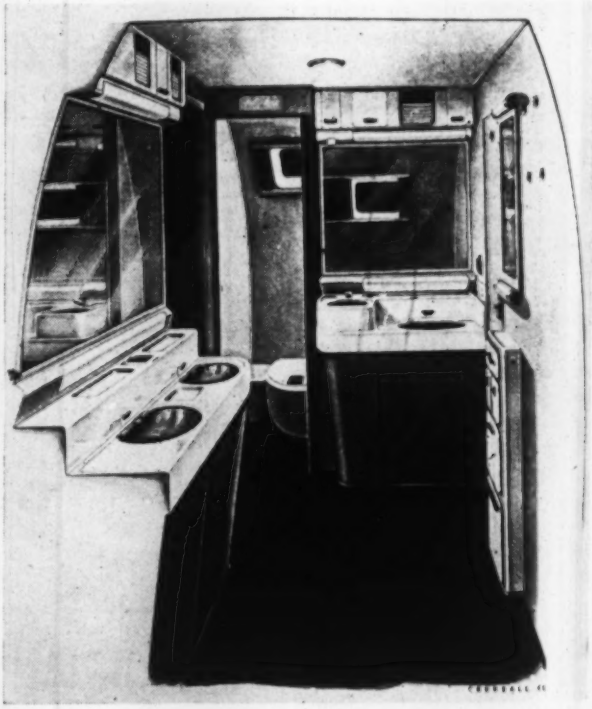


FIG. 1 DC-6 LUXURY TRANSPORT MEN'S LOUNGE AREA

[1] Formerly with Douglas Aircraft Company, Inc., Santa Monica, Calif.

Contributed by the Rubber and Plastics Division and presented at the Aviation Division Meeting, Los Angeles, Calif., May 26–29, 1947, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The same handling and optical properties that were needed in the windows were also desired in the mirrors used throughout the sleeper airplane. Here again, a special development program was required, this time, however, it was with the cooperation of the various plating concerns. The big problem was to find a technique for plating acrylics.

This problem was solved, and the acrylic mirror was created. However, in large mirror areas, the tendency of the mirror to warp required somewhat heavier sections than were normal to aircraft use.

Another problem of new material applications is typified by the miscellaneous knobs, buttons, assist handles, wash-basin handles, etc. In this case, the designer had to find a material which was strong enough to carry the required loading; a material that would impart a rich color for appearance; a material which would be warm to the touch; a material which would carry a flush letter that could not fill with soap, dirt, or other such contaminators.

A further complication developed in the matter of procurement of these items. While a great many different parts were involved, only a relatively few pieces of each individual part were required. As a result, the various custom molders were not interested in molding the parts. Therefore, the designer turned to the custom casting people for help.

The development program in this instance became quite extensive. A new translucent phenolic resin was developed to impart a rich color to the parts. The color range of the former opaque phenolics was very restricted. Another new "quick-set" resin was developed to create the white flush letters. The phenolic catalysts, plasticizers, and so on, were found to interact with the lettering resins formerly used and to cause them to change color. Of course with two new resins involved, a corresponding new casting technique had to be developed to match their special characteristics. The casting techniques employed a phenolic tool and centrifuge equipment. With simple tooling of this nature, the short runs of aircraft parts were met and the strength and appearance requirements were maintained.

Floor covering presented another interesting example of development with new materials to meet a fixed set of requirements. The airlines requested a floor covering with the following qualities:

It must feel like carpet; it must be washable. It must be replaceable; it must have good wear resistance; it must be attractive to the eye; it must not burn.

The designers selected from the known materials the versatile vinyl chloride. It is tough! Tests indicated it can outwear truck tires 10 to 1 according to National Bureau of Standards wear tests. It is inherently fire-resistant. It can be manufactured in an infinite variety of colors. It resists water and solvents.

The problem was to make the material look and feel like a carpet. The designers contacted the manufacturer, and a fire-resistant neoprene foam, applied as a backing to the vinyl floor covering, was developed. The vinyl film was supported by cloth and was embossed to impart a texture to the surface. The neoprene was also backed with cloth and the assembly was laid on the floor with a mastic. The resultant carpet could be lifted by pulling the neoprene backing cloth free of the mastic.

The carpet had color, wear and fire resistance, washability, texture, and feel. All the design requirements were satisfied and a new material application was created. The vinyl-coated fabrics were also textured by embossing rolls and used for head, sidewall, and partition lining materials. Vinyl-chloride extrusions both flexible and rigid followed in close sequence.

Fiberglas cloth laminates were studied by the designers and in their properties were found the answers for such applications

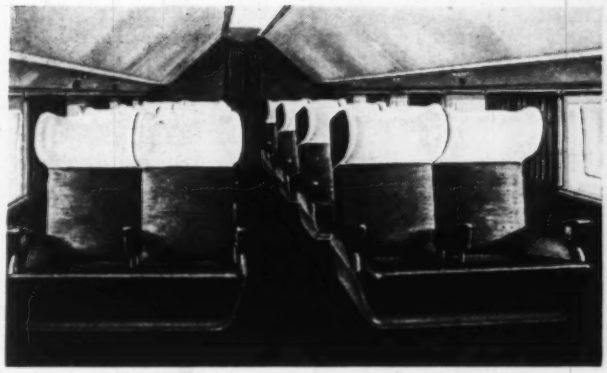


FIG. 2 DC-6 FORWARD PASSENGER CABIN AREA

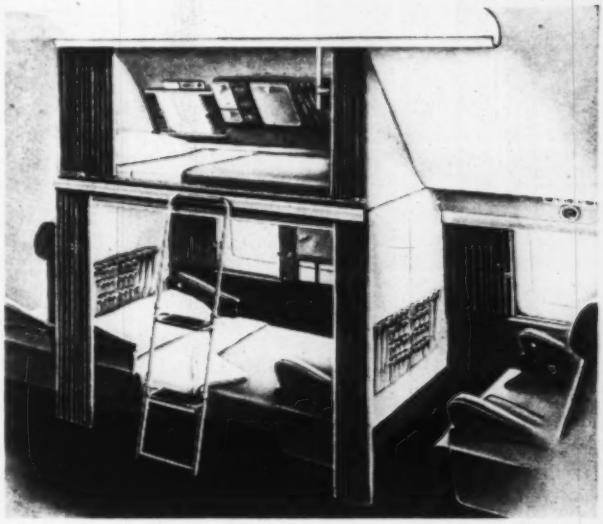


FIG. 3 DC-6 UPPER AND LOWER BERTH—FORWARD CABIN AREA

as window frames, sidewall liners, cargo-area liners, and contoured lighting troughs. Dimensional stability, high impact and tensile strength, ease of forming complicated shapes, and fire resistance were typical properties required of the fiberglas.

Probably one of the most interesting materials uncovered in in the designers' constant search for new materials was "Es Es Hardboard." The material is a thermoplastic of very high impact strength and wear resistance. It has unusually good draw characteristics and an excellent dielectric strength. Hence it became a logical selection for electrical housings, cover plates, and other similar deep-draw parts.

PLASTIC APPLICATIONS IN LUXURY TRANSPORT, THE DC-6

With a few of the many problems which face airframe-interior designers in mind, let us take a brief tour through one of the new luxury transports, the Douglas DC-6, and note the many contributions of plastics to air travel.

To aid in visualizing the type of plane to be considered, the following data are of interest: The DC-6 is a conventional four-engine metal monoplane, designed to carry 52 passengers in its day-plane version, and 26 passengers in berths and two in seats in its sleeper version. Both versions carry a crew of 5 with 7240 lb of cargo. It has a cruising speed of 300 mph and a useful load capacity of 33,311 lb. Apart from these rather cold figures, the endeavor has been made to incorporate in its design

a measure of comfort and luxury which has become expected in air travel. Plastics have truly contributed much to this end.

The layout of the DC-6 is as follows: Starting at the pilot's compartment in the extreme forward position and then progressing aft, we pass through the crew's quarters and cargo stowage, the men's lounge, the forward cabin, the coatroom, galley and main entry area, the aft passenger cabin, and finally we arrive in the ladies' lounge in the extreme aft end of the fuselage.

The application of plastic materials in this airplane may be considered in the same sequence as the arrangement. For the sake of this discussion, we will confine our study to the portion of the airplane to which the traveling public will be exposed, thus leaving the pilot, crew, and stowage areas of the ship for later discussions.

Fig. 1 is a view of the forward or men's lounge area. Six different plastic materials are incorporated in thirteen different applications in this area. The acrylics are used for windows, mirrors, and light housings. The accessory-cabinet handles, sink-fixture handles, assist handles, and other miscellaneous handles are cast in a translucent phenolic. The vinyl-chloride family supplies the floor covering, head, sidewall, partition linings, and floor cove molding. Cellulose-acetate butyrate forms the curtain slide track and recessed coat hooks. Fiberglas forms the window frame, and all the enameled surfaces are of alkyd-base-resin surface coatings.

The forward cabin section, shown in Fig. 2, features some thirteen plastic contributions to design, employing seven different plastic materials. The acrylics again supply the windows and trough light housings, supported in design by fiberglas window frames and contoured ceiling reflector panels. The versatile vinyl chloride provides floor covering, head, sidewall, and partition linings, seat-side-panel covering, and floor cove moldings. Cellulose-acetate butyrate is used in the curtain slide tracks. Cast phenolics form the seat push buttons. Foam rubbers of synthetic origin supply the seat cushions, and finally the enamel trims are supplied by the alkyd family of resins.

Opening a berth in the forward cabin section, as shown in Fig. 3, reveals some four additional plastic applications. A

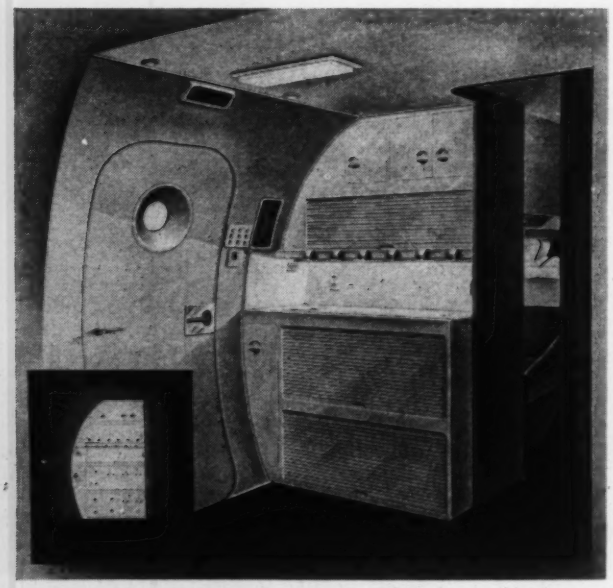


FIG. 4 DC-6 MAIN CABIN ENTRYWAY AND GALLEY AREA

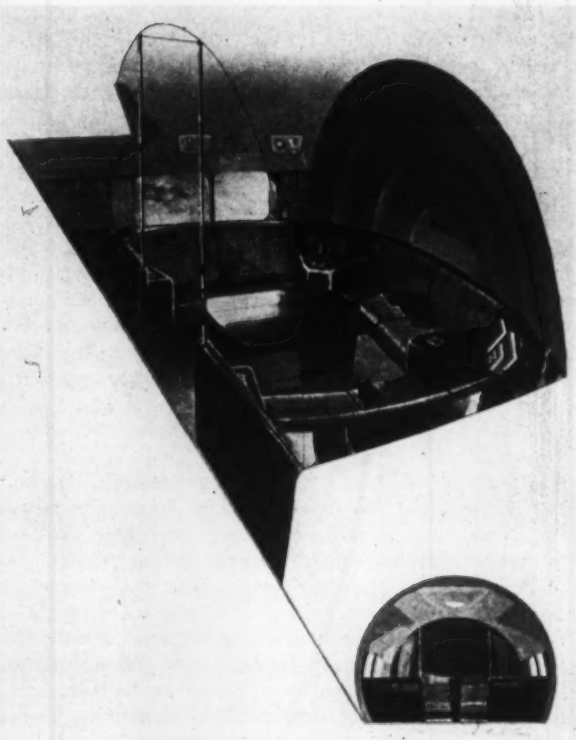


FIG. 5 DC-6 COMMUNITY LOUNGE—DAY-PLANE VERSION

neoprene-coated fabric is laced into the berth to provide a somewhat elastic support for the fiberglas mattress pad (foam-rubber pad is also supplied at the customer's request). Vinyl chloride covers the ladder-stair treads and provides the retainer strips for the berth curtains and pockets. The acrylic family supplies the garment hangers in the berth.

Fig. 4 shows only a small view of the main cabin entryway, galley, and coatroom area. Here again the acrylic, fiberglas, phenolics, vinyl chlorides, and alkyd resins provide the windows and lighting covers, window frames, galley accessory knobs, lining, and moldings, and surface coatings, respectively.

In the aft section of the fuselage is the women's lounge area. Again we find that the acrylic family supplies the windows, mirrors, and light-fixture cover plates. The accessory and lavatory handles, and knobs are of translucent cast phenolic. Vinyl chloride is again applied as linings, floor covering, and floor moldings. Cushions for the seats and the pinch strips on the doors are of foam rubber, and the recessed coat hooks are of cellulose-acetate butyrate. Enamel for the shrouds and miscellaneous trim is of alkyd-resin base.

In the dayplane version, this same aft area is converted into a community lounge as shown in Fig. 5. It is of interest because of its acrylic partitions and its decorative melamine-laminated table tops.

OTHER APPLICATIONS OF PLASTICS

Less conspicuous of the plastic applications are the following:

Foam rubber of synthetic latex forms the seat cushions and mattress pads. This material has proved to have a long fatigue life, a good spring rate, when selected in proper density for the application, and excellent passenger-comfort characteristics. The synthetic rubbers find numerous other applications, such

(*Continued on page 1026*)

Integrated FOREST UTILIZATION *in the* PACIFIC NORTHWEST

By O. HARRY SCHRADER, JR.

ASSOCIATE PROFESSOR, COLLEGE OF FORESTRY UNIVERSITY OF WASHINGTON, SEATTLE, WASH.

THE strides which have been taken during the last decade in improving forest utilization in the Northwest have undoubtedly equaled the progress made in this field during the preceding 40 years. This progress has been notable in all of the various fields of endeavor concerned with the embracing title of "forestry." Forestry as a science may be divided into four distinct phases, namely, forest management, logging engineering, forest sciences, and forest products or utilization.

THE FOUR ASPECTS OF FORESTRY

Forest management is concerned primarily with the problem of maintaining economically a continuous crop of timber trees to supply the needs of industry, and also for recreational purposes. Methods of cutting, protecting, and reforesting which were solely textbook theories 20 years ago are today in general usage and, in fact, are controlled or made mandatory in some states by law. Increasing co-operation between private, state, and federal forest ownership is making possible the establishment of large areas of forest lands as single management units designed to furnish a perpetual supply of raw material that will maintain the industrial capacity of plants in the area and will provide permanent employment for workers.

The logging-engineering field has kept pace with the rapid development in mechanical handling equipment which has demonstrated ability to handle logging in some of the roughest terrain in this country. Tractors and accessory equipment have replaced many steam and electric stationary engines for bringing logs to the railroads or truck road for the haul to the mill, and in addition to increasing the efficiency of this operation, have decreased losses resulting from damage to standing timber. The logging engineer, cognizant always of the risk of fire in the woods and the attendant difficulties of suppression, has assumed the task of laying out permanent road systems in connection with the logging operation which make possible ready access to all parts of the area in case of fire and permit rapid suppression.

The field of forest sciences is perhaps the least known and publicized of all forestry activities. It relates to protection of the forests from the depredations of insects and disease and the development and conservation of fish and wild life. Control methods today make use of such modern equipment as airplanes for survey of infested areas and treatment with toxic agents. Co-operation with the management forester and logging engineer results in better utilization of infected standing timber before it deteriorates beyond a salvage value.

RANGE OF FOREST PRODUCTS

Forest products or forest utilization is a technology of many facets. It includes the establishment of standards of utilization of timber in the woods, its mechanical or chemical breakdown into usable products with a minimum of waste, and the sale of a myriad of products either as finished items or as components for other products.

The degree of utilization which can be obtained in converting standing timber into usable products depends on many factors. A few of the more important items in this category include cost of the standing timber, quality of timber, species, size of individual trees, topography, logging equipment employed, type of conversion plant including size and location, market value of products, and many others. The merchantable volume of a standing tree varies with many factors, but considerable reliance has been placed on a figure of 65 to 70 per cent until recent years. The remaining volume contained in the stump, top, and branches is generally allowed to remain in the woods. This figure does not account for a sizable volume in trees or logs remaining on the area after logging is completed because of rot, breakage, poor form, excessive roughness or other defects. Grondal (1),[1] in reporting a survey made in 1941, of usable material left on recently logged areas, showed an average of 31,929 fbm per acre remaining on the ground after logging on 20 sample plots in widely scattered areas of the State of Washington.

Since 1942 utilization standards have changed radically and have undoubtedly resulted in a drastic reduction of this figure. According to Grantham (2), many operators, in addition to improving their utilization standards, have begun exploratory work in relogging cutover areas and have realized economical salvage of much pulpwood. Smaller quantities of sawlogs, peeler logs, and miscellaneous products have been recovered in some operations.

The United States Forest Service in a current report (3), citing statistics for the year 1944, has assembled considerable data on the volume of wood waste resulting from logging and manufacturing various wood products. This report indicates that only 32 per cent of the total merchantable volume of timber on an area reaches the market as lumber when this is the primary product. The remaining 68 per cent is logging and milling waste of which about one third is used for fuel. The manufacture of pulp utilizes 75 per cent of the available volume, although much of this is later wasted by being discharged with spent cooking liquors. It is apparent that great opportunities exist in various phases of the lumber industry to improve the utilization of material that is being cut from our forested areas.

AN EXAMPLE OF INTEGRATED UTILIZATION OF TIMBER

The primary purpose of this paper is to report integrated utilization of the timber that is brought out of the woods. In this connection, the privilege has been assumed of selecting one of the major lumber operations in the Northwest[2] as the object of this report. It must not be assumed that this is a typical operation, if indeed there is such a one, but the selection has been based upon the following factors: This operation is one of the largest from the standpoint of volume of timber processes.

Contributed by the Wood Industries Division and presented at the Annual Meeting, Atlantic City, Dec. 1-5, 1947, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[1] Numbers in parentheses refer to Bibliography at end of paper.

[2] The Weyerhaeuser Timber Company, Longview, Wash.

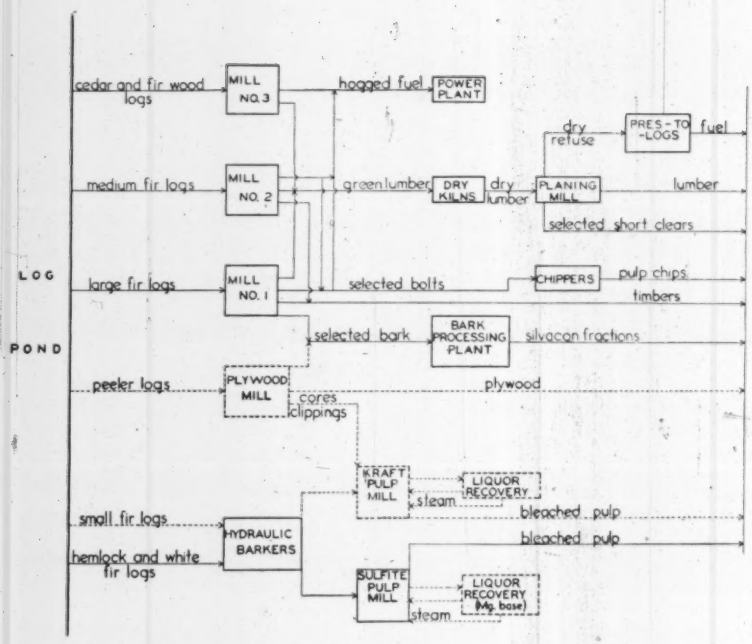


FIG. 1 FLOW CHART OF LONGVIEW OPERATION OF WEYERHAEUSER TIMBER COMPANY

and in physical layout that exists in the world. It is adequately capitalized, modern in all respects, has a permanent supply of timber to support its operations, and, finally, has the will and desire for research and the development of better utilization and new products. Many of the phases of the operation to be described could be undertaken only by an organization of this size and should in no way be considered to reflect on other operations in the Northwest.

The physical plant layout of the company in question consists of the following principal units concerned with the manufacture of primary or finished wood products, all units being contained in a single operating area and served by the same woods operations: three sawmills, a planing mill, a Pres-to-Log plant a sulphite-pulp mill, and a bark-processing plant. Under construction at the present time and scheduled to be in operation soon are a plywood mill and a sulphate- or kraft-pulp mill. The flow chart, Fig. 1, indicates the relationship of these units to the over-all flow of raw materials and recovery of by-products.

FACTORS RELATING TO SAWMILL OPERATION

Prior to a detailed discussion of the operation of the sawmills, several factors should be considered as they relate in general to sawmill operation. The mechanical breakdown of logs into lumber items produces a certain inevitable amount of unutilized material which is often inaccurately dubbed as "waste" when measured by lumber standards. This material accumulates because a log is round and must be squared up to make lumber, because sawdust is produced in cutting to usable sizes, and because it is necessary to trim in cutting out natural defects.

In 1931 Hodgson (4), in a detailed report of sawmill waste, indicated that approximately 33 per cent of the original gross log volume was accumulated as sawdust, slabs, edgings, and trims in sawing logs to lumber. A more recent study by Bradner (5) indicated that about 31 per cent of the merchantable log volume was lost in log conversion to lumber. While this percentage has probably decreased slightly in recent years with an increase in the marketability of low grades of lumber, it is nevertheless axiomatic in sawmill operation that a sizable volume of material of this nature will be developed coincident with the mechanical breakdown of logs. The economical utilization of this material is therefore an important factor in the successful operation of any sawmill.

The size and layout of a sawmill are often geared to the size and quality of logs to be cut and the type of product to be marketed. For example, some mills cater particularly to the export and timber trade and therefore require a minimum of resaw and planing equipment; others may cut entirely in second growth or lower grades of virgin-timber logs and market their product chiefly as green common and structural lumber. The most versatile and complicated operation is that of sawing logs from large virgin timber which will yield a relatively high percentage of clear lumber and also produce lumber of all grades and sizes. Such mills must have a wide range of resawing equipment efficiently laid out, as well as facilities for drying and remanufacturing.

In the operations being described,[2] each of three sawmills is designed to operate efficiently on logs of different sizes and character. Mill No. 1 is primarily a "quality" cutting mill. In essence it consists of a single band headsaw served by an edger and trimmer, followed by two pony band headsaws, an edger, trimmers, an American type sash gang saw, and several band resaws, re-edgers and retrimmers. Logs selected in the log pond (Fig. 2) for diversion to mill No. 1 are large, typical virgin-growth Douglas fir, *Pseudotsuga taxifolia*, Lamb., Britt., which yield a high percentage of clear lumber and structural-grade timbers. This mill pays particular attention to cutting for a maximum of overrun and quality lumber. Bradner (6) has pointed out in a detailed study that the percentage of overrun is decidedly increased in quality sawing by frequent turnings of the logs on the carriage, light slabbing, and proper taper setting.

Overrun is frequently used as a gage of sawmill efficiency, although as such it is not a strictly reliable measure. Most log rules compute the volume of lumber which may be cut from a log on the premise that the log will be sawed entirely into 1-in. boards using a heavy-gage saw and deduct approximately 20 per cent of the potential log volume for saw-kerf losses. Therefore logs sawed into 2-in. and heavier stock will show high yields compared to those sawed into 2-in. stock and less. Overrun will, however, reflect the gains from light slabbing, good edging and trimming, and the use of lighter-gage saws in breaking down cants produced on the main headsaw.

At mill No. 1, the headrig slabs the log, then cuts cants from the outer portion of the log to be detoured to the gang saw and pony headrigs. Common and structural grades of lumber are then cut from the remainder of the log, and frequently

TABLE 1 GRADE SUMMARY OF A TYPICAL DAY'S SAWMILL PRODUCTION[3]

	Mill No. 1	Mill No. 2	Mill No. 3	Total
Daily production,[a] in Mbm.	658	554	136	1348
Grade	Per cent of production			
D and better clear	59.0	39.0	17.2	38.4
1-in. and 2-in. commons	12.2	37.0	38.0	29.1
3-in. and thicker commons	2.6	8.5	2.4	4.5
No. 3 common	1.1	3.2	16.2	6.8
Shop grades	8.4	0	16.2	8.2
Timbers	13.7	7.3	0	7.0
Dunnage	3.0	5.0	10.0	6.0

[a] Mill No. 1: an 8-hr day shift and an 8-hr night shift. Mill No. 2: 8-hr day shift only. Mill No. 3: 8-hr day shift only.

timbers are derived from the center portion. The gang saw and pony headsaw (Fig. 3), operating with smaller-gage thinner saws, break the cants down to marketable 1 and 2-in. clear and common lumber in accordance with the sawyer's best judgment. Further opportunities to upgrade this material are afforded by equipment in the resaw room. The over-all principle of sawing for quality in this mill and proper log selection is reflected in the summary figures in Table 1, which indicate that nearly 60 per cent of the output of this mill is clear lumber, and that an additional 8.4 per cent shop lumber is derived under typical operation conditions. Fig. 4 shows the sorting on green chain where lumber is segregated according to size and grade.

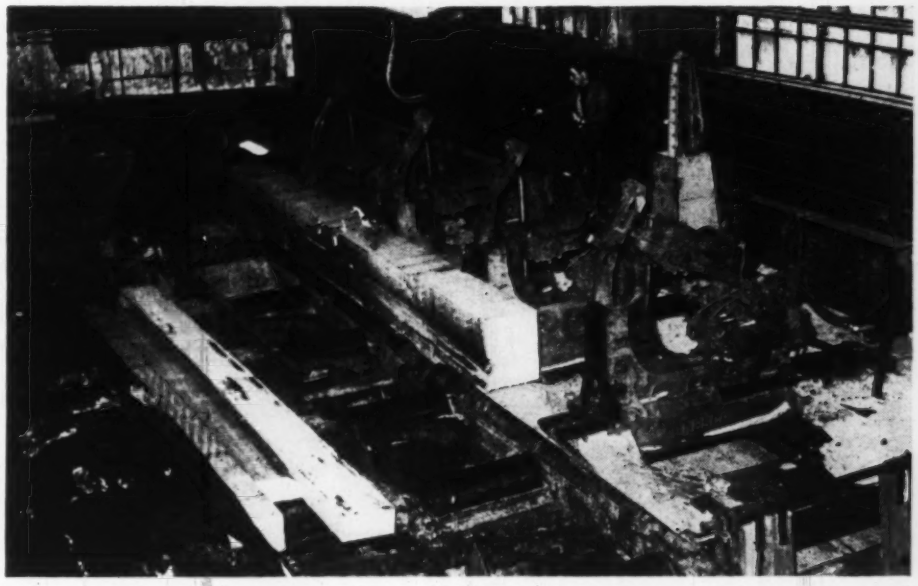


FIG. 3 DOUBLE-CUTTING PONY BAND HEADSAW IN ONE OF THE MILLS WHICH IS DESIGNED FOR QUICK EFFICIENT CONVERSION OF CANTS TO LUMBER

Mill No. 2 has the largest capacity of the three sawmill units and cuts approximately 500,000 ft of lumber in an 8-hr shift. The logs which are routed from the pond to this mill are Douglas-fir logs that did not qualify for mill No. 1. They average smaller in size, lower in quality, and do not yield as much clear lumber, but are quite variable in diameter and length. The mill is equipped with three band headsaws, one of which is designed to handle the larger heavier logs, and the other two are particularly suited to sawing the smaller and shorter logs. Conventional edging and trimming equipment is employed with sufficient capacity to serve the four headrigs. Extensive resaw equipment is also included in the mill layout, but is not as flexible as that incorporated in mill No. 1. Referring again to Table 1, it can be seen that the output of mill No. 2 consists of about 40 per cent clear, 48 per cent common, and the remainder in timbers and dunnage.

Mill No. 3 in the arrangement being discussed is designed to cut the low-grade or "wood" logs of Douglas fir, and logs of other species. Until recent years a good portion of the cut from this mill was western hemlock *Tsuga heterophylla*, Rafn., Sarg., but the increased value of this species as a pulpwood has caused all hemlock to be routed to the sulphite-pulp mill. Prior to the installation of the new cut-up mill, hydraulic barker and log chippers, mill No. 3 was employed in breaking down hemlock and white-fir logs to convenient bolt sizes to be chipped for the manufacture of pulp.

Mill No. 3, with a daily cut of from 100,000 to 140,000 fbm, is principally engaged in sawing western red-cedar, *Thuja plicata*, D. Don logs and low-grade fir logs in the present arrangement. Served by a single band headsaw, it is essentially a short-log mill and has the usual supplementary edging and trimming equipment and gang saws for reducing high-grade cants to boards.

Typical old-growth cedar logs are often hollow, and the butts are fluted and flared. These characteristics tend to reduce quantity of production because of handling difficulties at the head end of the mill, and require slightly different layout of equipment for efficient operation. Table 1 indicates that the output of mill No. 3 runs very heavily to common lumber with the clear averaging about 17 per cent of the total production.

In reviewing the figures on

FIG. 2 GENERAL VIEW OF LOG POND AND SORTING POCKETS ON COLUMBIA RIVER ADJACENT TO OPERATION

(Log haul-up for Mill No. 1 is visible in the foreground.)

FIG. 4 SORTING ON GREEN CHAIN FROM MILL NO. 1 WHERE LUMBER IS SEGREGATED ACCORDING TO SIZE AND GRADE

the production of each mill, it should be borne in mind that the volume of timbers cut is quite variable from day to day. Unlike most other lumber items, timbers are not generally kept in stock. The great variety of sizes and lengths that are employed in different types of construction make it impractical to attempt to stock timbers and they are accordingly manufactured to order.

METHODS OF UTILIZING SAWMILL WASTE

The offal from the three sawmills operating on a typical day will consist of 2424 tons of wood material in the form of sawdust, slabs, edgings, trims, and accumulated chunks and splinters of bark and wood. Several methods of utilizing some of this material readily suggest themselves, such as fuel for the power plant, sale as domestic fuel, manufacture of wood lath, and for pulping. Ideal utilization demands that this material be used most economically or sold to bring the maximum financial return.

The company in question operates its own power plant to furnish the necessary steam and electricity required for its entire establishment. The furnaces in this power plant are of the Dutch-oven type specially designed to burn hogged fuel, i.e., hogged wood and bark refuse from the sawmill offal in admixture with sawdust. In recent months it has been found that, as a result of other utilization of sawmill offal, the available hogged fuel does not meet the power plant's daily requirement of 1924 tons, so that it has become necessary to employ fuel oil to augment the available wood fuel. This development is extremely significant in that it places a definite minimum monetary value on so-called mill waste, a value equivalent in terms of weight and available heat units to the delivered price of fuel oil. This trend marks the end of that old familiar landmark of the sawmill, the refuse burner, designed to consume excess mill waste to prevent its accumulation at the mill site.

Refuse from the sawmills is dumped into conveyers below the main sawing floor and passes before a group of trained pickers. The selection of material by these pickers for various potential uses represents one notable advance in improved utilization. In former years a few choice bolts were selected from the conveyer for the manufacture of wood lath, and the remainder of the material was hogged and burned or sold as domestic fuel. Wood-lath manufacture, which has never been a particularly profitable venture in the lumber industry because of the low market value of the product, was discontinued at the company's operation on July 1, 1947, of this year.

Today, pickers on the waste conveyer are sorting material for three principal purposes. Chunks of bark are set aside for the bark-processing plant. Trims which will cut into short clears are picked out, bundled, dried, and subsequently sold for use in manufacturing furniture and specialty items of many kinds. The greatest volume of material selected from the conveyers is suitable for making pulp chips. Such bolts can be of any size and shape, but must be reasonably clean, contain no rot, and have a minimum of bark and defects. These selected bolts are routed to a chipper, chipped to suitable size, and loaded on scows for shipment to a near-by pulpboard mill.

In summarizing the operation of the sawmill units, the records show that 850,000 fbm of log scale yield 1,000,000 fbm of lumber. In the process of converting the logs to lumber, 10,000 fbm of short clears suitable for use in furniture and specialty manufacture are recovered, 200 units[3] of pulp chips are obtained, 30 tons of bark are recovered for processing, and about 1000 tons of boiler fuel for the power plant is accumulated.

PROCESSING OPERATIONS

The principal portion of the lumber cut of the three sawmills is routed through the dry kilns and then to the planing mill. The planing mill handles a daily output of 1.1 mm to 1.5 mm fbm per day in two shifts. Clear and common items are surfaced and/or run to the pattern of such items as flooring, ceiling, siding, shiplap, and moldings of many types. Pattern items and clears are bundled and marked with a trade-mark and grade.

The process of reducing the rough lumber to surfaced dimensions or required patterns results in a material reduction of weight which is converted to planer chips and shavings. Under average conditions of operation, 350 tons of planer-mill refuse are produced in handling 1,000,000 fbm. This material is suitable for power-plant fuel, and the greater proportion of it is disposed of in this manner.

The Pres-to-Log unit previously mentioned (Fig. 5) makes use of a substantial portion of this planing-mill refuse. A Pres-to-Log is a compressed briquet which weighs about 8 lb and is about 3 times the density of normal wood. The briquets are formed by packing planer shavings in a forming mold at pressures approximating 50,000 psi. The logs are then cooled in the mold until they can be ejected to the atmosphere without any danger of spontaneous combustion. The Pres-to-Log plant, operating 24 hours a day, utilizes 120 tons of planing-mill refuse. The manufacture of Pres-to-Logs should not be regarded strictly as a phase of waste utilization, since the planing-mill refuse is valued as a powerhouse fuel because it is

[3] A unit consists of 200 cu ft.

drier than hogged mill waste. Rather it is an example of conversion or diversion of material into a product of increased value.

BARK-CONVERSION PLANT

In June, 1947, the company made the first public announcement of its newly constructed bark-conversion plant. The processing of Douglas-fir bark to yield a variety of products had its inception in studies designed to produce a cork substitute for natural Mediterranean cork when imports were cut off during the recent war. Subsequent laboratory research developed products other than cork from the bark.

The present installation, which is more or less in the pilot-plant stage, is capable of processing 75,000 lb of bark daily into five separate fractions. The plant uses only the bark of old-growth or virgin Douglas fir as it is characteristically thicker and higher in cork content than the bark of smaller logs. In processing, the bark is ground and broken up by a variety of mechanical means and then separated into fractions by screening (Fig. 6). The finished fractions vary from a fine, reddish-brown powder, derived principally from bark fiber, to a relatively coarse mixture of cork flakes and fiber. The separate fractions are sold by number under the trade name of "Silvacon" and have thus far demonstrated valuable properties for such uses as molding powders, active extenders for phenolic glues, a soil builder, specialty fuels, fillers for linoleum, and similar products, cleaning and buffing compounds, carriers for insecticide sprays, and many other uses.

The bark of old-growth Douglas fir is estimated to comprise approximately 12 per cent of the volume of the log although this volume is not included in the log-scale tally. Although the present bark-processing facilities do not begin to utilize the available volume of fir bark from the sawmills, it is indicative of the possibilities which exist in this development as markets for the bark products are created by research.

FIG. 5 DISCHARGE END OF A PRES-TO-LOG MACHINE
(Compressed-wood briquets manufactured from shavings and sawdust from the planing mill are one of the by-products of lumber manufacture.)

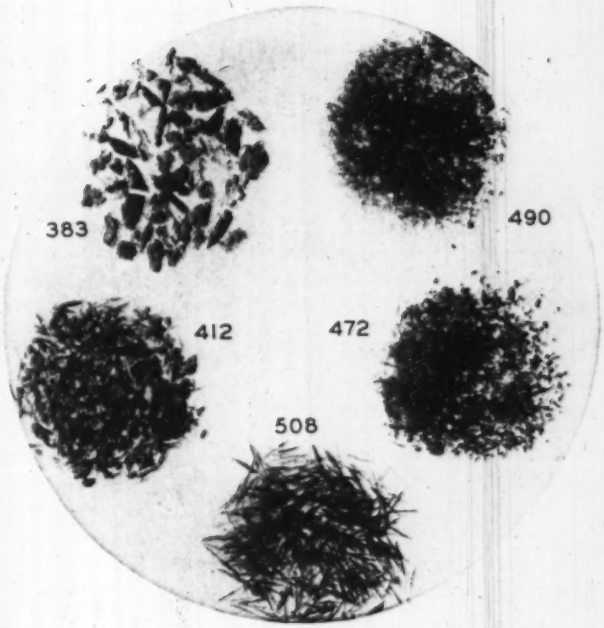


FIG. 6 PHOTOMICROGRAPH OF FIVE FRACTIONS PROCESSED FROM DOUGLAS-FIR BARK, ILLUSTRATING GROSS PHYSICAL PROPERTIES

PULP-MILL OPERATIONS

The present sulphite-pulp mill at the plant site produces approximately 265 tons of air-dry bleached sulphite pulp per day. To produce each ton of pulp requires 875 fbm log scale, or the pulp-mill consumption amounts to 231,875 fbm log scale per day. Western hemlock is the principal species employed in the manufacture of sulphite pulp, but approximately 20 per cent of the total wood volume used is white fir *Abies grandis*, Lindl.; *Abies nobilis*, Lindl.; and *Abies amabilis*, Forbes. Douglas fir is not regarded as a suitable species for the manufacture of sulphite pulp, and the pulp mill is unable to employ any portion of the offal from the sawmills for raw material.

One recent innovation connected with pulp production has had a material effect on utilization of raw material. This development, the hydraulic barker, is rapidly becoming standard equipment for barking pulpwood logs. The hydraulic barker peels the bark from the log by directing a stream of water from specially designed nozzles at pressures of approximately 1400 psi. Proper timing and movement of the log and nozzles results in debarking the log in the shortest possible time with no loss of sound wood. This method of bark removal in conjunction with whole-log chippers which will chip logs up to 48 in. diam has reduced the wood requirement per ton of air-dry pulp from 1000 to 875 fbm. The reduction represents the combined savings of wood formerly lost by conventional barkers and loss in slabs and saw kerf incident to breaking logs down to small flitches for ease of barking and chipping.

The production of sulphite pulp utilizes less than 50 per cent of the gross wood volume, as the remainder is discarded with the spent pulping liquor into the nearest available watercourse. This wastage has long been the most pressing problem of the industry not only from the standpoint of loss of raw material

and chemicals but as a public-nuisance factor in the pollution of water. Under construction at the present time in connection with the existing sulphite mill is a liquor-recovery plant.

This new recovery process entails a shift from pulping with a calcium-base liquor to a magnesium-base liquor. Magnesium lignosulphonate, a primary ingredient of the spent liquor, can be reduced economically to caustic magnesia under controlled operating conditions in a recovery system. A similar reaction cannot be produced when a calcium-base liquor is used. The process of recovering the magnesium base involves principally evaporating and burning and, in this process, the fuel value of the organic solids derived from the wood is largely recovered.

The chemical features of the process have been outlined in a recent paper by R. S. Hatch (7).[4] The heat derived from this recovery process will be employed in furnishing the power requirements of the pulp mill, and it is expected that the pulp mill will become self-sufficient in this respect. At the present time the pulp mill draws steam and power from the main power plant, and the expected decrease in this requirement will make available more of the wood waste, which is now being burned under the boilers, for the manufacture of kraft pulp.

Other company units under construction at the present time will serve to round out the present program of integrated utilization of the available raw material.

NEW PLYWOOD MILL BEING CONSTRUCTED

The new plywood mill will permit bettter utilization of available logs. "Peeler logs" or logs specifically suited for the production of rotary-cut Douglas-fir veneer must be best quality logs of large diameter. Maximum value will be attained by peeling logs which have a relatively large proportion of clear material in the outer portion and are free of shakes, checks, or other defects that would cause them to break up on the lathe, or result in the production of poor-quality veneer.

The addition of the plywood mill to the present plant will permit routing only the finest quality logs to the lathes and prevent costly tie-ups resulting from defective logs which have become everyday occurrences in many western plywood mills. Plans call for utilizing the bark from the plywood mill for the bark-processing plant. As most peeler logs are butt cuts from old-growth timber, the bark will be of ideal quality for this purpose. Typical waste accumulation at a plywood mill consists of cores of peeler logs 7 to 9 in. diam, clippings and trims from veneers and panels, and irregular scraps and shavings from the jointing and patching operations. This material can be utilized as raw material for the kraft-pulp mill now under construc tion, or it may be hogged for power-plant fuel.

NEW KRAFT-PULP MILL

The sulphate or kraft-pulp mill now under construction and which will soon be operating will complement the operation of the sawmills and plywood mill. The mill is planned to have a capacity of 200 tons of air-dry Douglas-fir kraft pulp per day, and therefore will require 175,000 fbm of logs or its equivalent in other forms. This required footage will be obtained from the sawmill waste conveyers and the plywood-mill waste. It can be augmented by chipping lower grades of fir logs which scarcely pay their way through the sawmill.

Small logs less than 18 in. diam, which in the past have frequently been left on the ground by the logger, will be removed and shipped to the mill site either during the primary logging or by salvage operations. A small-log hydraulic barker will be installed to debark these logs and after chipping the material will be routed to the kraft mill or sulphite mill depending on the species. Logs of this type may also be removed in the course of thinning operations first and improvement in second growth.

[4] Director of Research, Pulp Division, Weyerhaeuser Timber Company.

RECOMMENDATIONS FOR REDUCING VOLUME OF WASTE

The United States Forest Service report on wood waste (3) contains some recommendations designed to reduce the volume of waste resulting from wood-manufacturing processes. Greater integration of timber-products industries is stressed and the report points out that "one-product operating, still typical of the forest industries in this country, tends to be wasteful."

Integration of wood utilization, as typified by the operations described, is not concerned solely with attempting complete utilization of the available raw material. The versatility of the various manufacturing units which make up this industrial plant permits not only a relatively complete utilization but a utilization that is best suited to the characteristics of the type and quality of raw material, as well as a utilization which gives the maximum financial return for each class of material.

Hemlock and white-fir logs which make ideal sulphite pulp are used solely for this purpose. Old-growth Douglas-fir logs, containing a high percentage of clear lumber, are routed to a sawmill specifically designed for quality recovery with a minimum of waste. Smaller and lower-grade logs are diverted to mills equipped to break them down efficiently. Sufficient kiln-drying capacity and planing-mill capacity are available to finish the manufacture of lumber items so that they command a maximum market value. The installation of the plywood mill will offer the opportunity to select high-grade peeler logs for efficient conversion to rotary veneer. The sulphate mill will complete the setup by absorbing a good portion of the Douglas-fir waste which accumulates in the sawmills and plywood mill.

Behind these major manufacturing units is an intelligent salvage and development program utilizing sawmill waste for short clears, pulp chips, and boiler fuel, planing-mill waste for fuel briquets, and bark for a variety of new products. The part-time employment of oil as a fuel in a sawmill power plant is perhaps the most significant criterion of the changes that are taking place in integrating the use of one of our greatest natural resources—wood!

ACKNOWLEDGMENT

The author is grateful to the Weyerhaeuser Timber Company for the consideration and interest it has displayed in making available data and illustrations used in this paper. The assistance of Mr. Harry Morgan, General Manager of the Longview operations, Mr. Richard Hammond of the Industrial Research Section, and Mr. Albert Arnst of the Personnel Department in Tacoma, Wash. is appreciated.

BIBLIOGRAPHY

1 "Logging Waste and Its Potential Value in Pulp Manufacture," by B. L. Grondal, *Pacific Pulp and Paper Industry*, vol. 16, no. 2, 1942, pp. 18–21.

2 "Relogging Problems in the Douglas Fir Region," by J. B. Grantham, *Forest Club Quarterly*, University of Washington, Seattle, Wash., vol. 20, no. 1, 1946–1947, pp. 5–12.

3 "Wood Waste in the United States," Report No. 4 from "A Reappraisal of the Forest Situation," U. S. Dept. of Agriculture, 1947.

4 "Present Utilization of Sawmill Waste in the Douglas Fir Region," by A. H. Hodgson, *The Timberman*, vol. 32, 1931, no. 9, pp. 27–33; no. 10, pp. 25–31; no. 11, pp. 32–48; no. 12, pp. 36–46.

5 "Utilization in the Sawmill," by M. Bradner, *The Timberman*, vol. 28, no. 11, 1937, pp. 38–42.

6 "Sawmill Efficiency Not Measured by Volume of Production," by M. Bradner, *The Timberman*, vol. 28, 1937, no. 8, pp. 37–40; no. 9, pp. 40–44; no. 10, pp. 42–46.

7 "Magnesium-Base Sulphite Pulping," by R. S. Hatch, *Paper Trade Journal*, vol. 122, March 14, 1946, pp. 54–56.

An Approximate FORMULA *for* PIPE FRICTION FACTORS

By LEWIS F. MOODY

PROFESSOR OF HYDRAULIC ENGINEERING, PRINCETON UNIVERSITY. FELLOW A.S.M.E.

AS AN addendum to a previous paper on friction factors for pipe flow,[1] the following approximation is offered to supplement the charts given in that paper. While these charts, based on what is considered the best information now available, are convenient and adequate for the numerical solution of specific engineering problems, cases are likely to arise where we need not only specific values but an algebraic formulation for the friction factor. For example, in dealing with total losses in a system in which friction is only one of a number of factors, in handling a problem involving the solution of simultaneous equations, in differentiating for an optimum condition or in integrating total losses, or in any problem where we want an analytical solution, we may need an explicit expression for the friction factor as a function of the controlling variables.

As was pointed out in the paper and discussion, the charts are based on the Colebrook-White or "Colebrook" function, an equation which covers "the whole field of pipe flow above the laminar and critical zones," that is, the field of usual engineering problems. The Colebrook equation, however, like the Prandtl-Kármán equations on which it is based, is in transcendental form and contains the friction factor f on both sides of the equation. It is

$$1/\sqrt{f} = -2\log\left(\frac{\epsilon/D}{3.7} + \frac{2.51}{R\sqrt{f}}\right)$$

It is not susceptible to direct solution for f and requires either charts, tables, or successive approximations to extract the value of f.

The following approximation for this equation is now offered

$$f \cong 0.0055\left[1 + \left(20{,}000\,\frac{\epsilon}{D} + \frac{10^6}{R}\right)^{1/3}\right]$$

This formula is applicable over the usual range of engineering problems; specifically, it agrees with the Colebrook equation within an error of ± 5 per cent in the values of f for values of R from 4000 to 10^7, and for values of ϵ/D up to 0.01 or values of f up to 0.05.

The formula accomplishes two things, namely, it eliminates f from the right side of the equation, so that it gives a direct explicit solution for f, and it replaces the logarithmic form by a simple exponential one. It can be used for practical engineering purposes whenever charts or tables are not at hand, and with almost as much confidence as can be given to the Colebrook formula or the charts.

[1] "Friction Factors for Pipe Flow," by L. F. Moody, Trans. A.S.M.E., vol. 66, 1944, pp. 671–684.

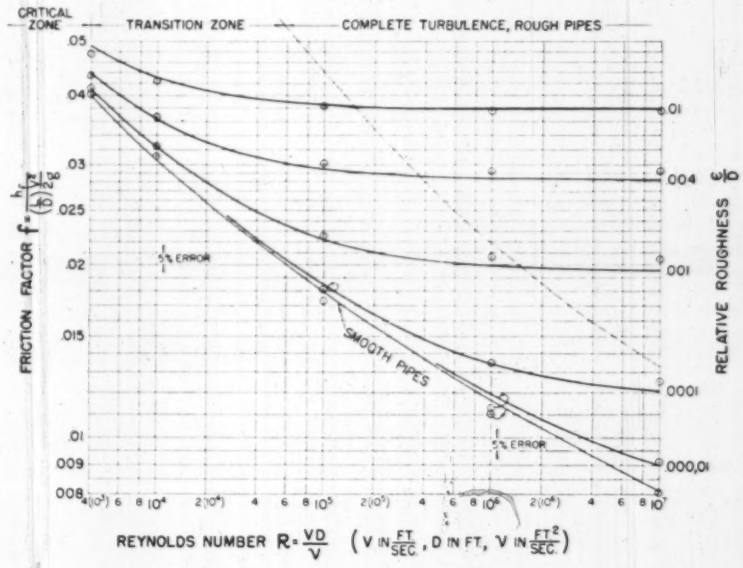


FIG. 1 COMPARISON OF FRICTION FACTORS FROM CHART WITH VALUES BY APPROXIMATE FORMULA

ϵ = absolute surface roughness, with the following recommended values:

	ϵ
Drawn tubing, brass, lead, glass, centrifugally spun cement, bituminous lining, Transite, etc.	0.000005
Commercial steel or wrought iron	0.00015
Asphalted cast iron (asphalt dipped)	0.0004
Galvanized iron	0.0005
Cast iron, average	0.00085
Wood stave	0.0006–0.003
Concrete	0.001–0.01, avg 0.003
Riveted steel	0.003–0.03, avg 0.01

In connection with the charts attention is also called to the supplementary chart Fig. 2, reproduced with the author's permission from a recent paper by A. B. Stickney.[2] This chart is in the form of a contour map of constant f values with the coordinates R and ϵ/D, which brings out the relative influence of the two factors and is a useful alternative method of plotting.

As was pointed out in the original paper, ".....it must be recognized that any high degree of accuracy in determining f is not to be expected. With smooth tubing, it is true, good degrees of accuracy are obtainable; a probable variation of f within about ± 5 per cent, and for commercial steel and wrought-iron piping, a variation within about ± 10 per cent. But in the transition and rough-pipe regions we lack the primary and obvious essential, a technique for measuring the

[2] "Friction in Pipes," by A. B. Stickney, *Refrigerating Engineering* (Journal of the A.S.R.E.), vol. 53, February, 1947, pp. 129–131.

roughness of a pipe mechanically." It may be added that there are also shortcomings in the basic theories, such as the discontinuity in the velocity-distribution curve at the pipe axis, and the unsatisfactory assumption as to the variation of "mixing length" based on the Prandtl approximation. In spite of these imperfections, the resulting functions have been found to be in satisfactory agreement with experiment; and the Colebrook transition function shows good agreement with the behavior of commercial piping.

A sense of proportion prompts us to remember that the forms of the equations do not represent ultimate perfection, that we have only crude descriptive methods for specifying surface roughness, and hence that high precision in formulation would have little real significance. It is from these considerations that the author in developing an approximate formula has discarded complicating refinements which would give increased "accuracy," in favor of simplicity, which was secured by rounding off and compromising the numerical factors.

It may be mentioned that in the rough-pipe zone of complete turbulence, applying the von Kármán relation

$$1/\sqrt{f} = 1.74 - 2\log\left(\frac{2\epsilon}{D}\right)$$

which may be expressed $f = \text{funct}\,(\epsilon/D)$, it was found that over the range

$$\epsilon/D = 0.00001 \text{ to } 0.01$$

f could be determined within about 2 per cent of agreement with the von Kármán function by the approximation

$$f(\text{rough pipe}) = 0.005 + 0.15\,(\epsilon/D)^{1/3}$$

or from

$$f(\text{rough pipe}) = 0.005 + 0.0055\left(20{,}000\,\frac{\epsilon}{D}\right)^{1/3}$$

Similarly, for perfectly smooth pipes ($\epsilon/D = 0$) it was found that the Prandtl-Kármán-Nikuradse relation

$$1/\sqrt{f} = 2\log \mathbf{R}\sqrt{f} - 0.8$$

could be closely approximated by

$$f(\text{smooth pipe}) = 0.006 + 0.0055\left(\frac{10^6}{\mathbf{R}}\right)^{1/3}$$

By using a transition function similar to Colebrook and White's, such that when $\mathbf{R}$ is large its effect disappears, and when ϵ/D is small its effect disappears, and by averaging the value of the constant term the final formula was derived. Fig. 1 shows points, indicated by circles, computed by the formula, in comparison with lines from the chart for several typical values of relative roughness ϵ/D. The formula may be applied to higher Reynolds numbers in the rough-pipe zone of complete turbulence, but in the transition zone, below the dashed line, it should not be used for extrapolation beyond $\mathbf{R} = 10^7$; nor should it be applied for values of f higher than 0.05.

Under existing limitations, feeling that variations in f within, say, 5 per cent are practically meaningless and that any closer agreement seems hardly worth striving for, the formula is presented in the hope that it will be found useful in engineering practice.

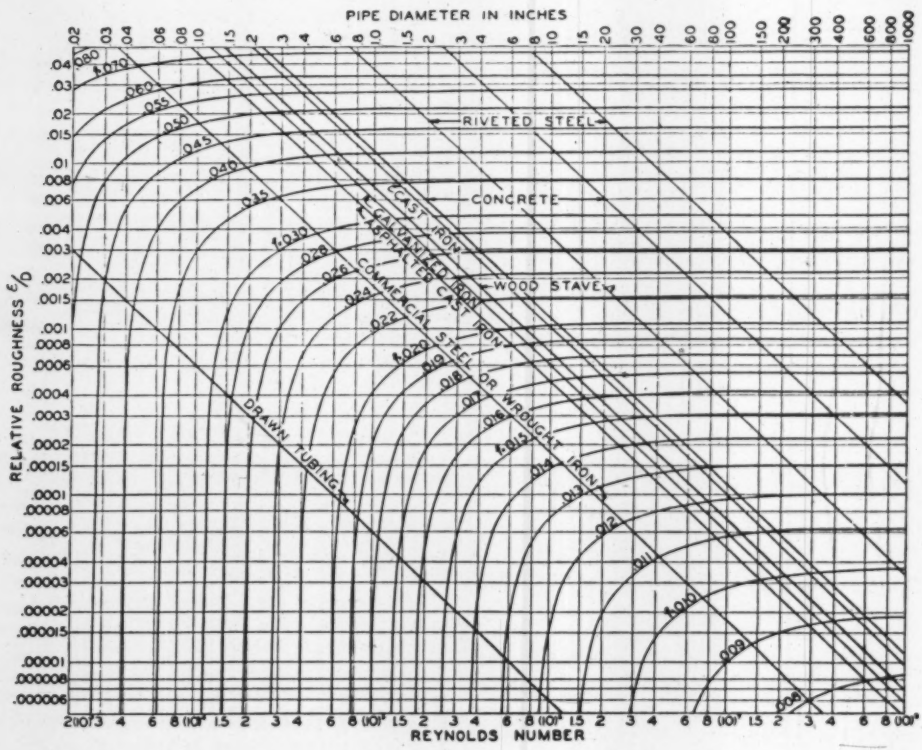


FIG. 2 CURVES GIVE f VALUES CORRESPONDING TO VALUES OF $\mathbf{R}$ (AT BOTTOM OF CHART) AND ϵ/D (LEFT-HAND SIDE)
(The superimposed diagonals reproduce Fig. 2 of the author's paper using scales at top and left-hand side.)

Co-Ordinating MATERIALS HANDLING *With the* MANUFACTURING CYCLE

By S. C. HOEY

DIRECTOR, HEADQUARTERS MANUFACTURING ENGINEERING DEPARTMENT, WESTINGHOUSE ELECTRIC CORPORATION

MATERIALS handling is as much a part of the cost of a manufactured item as the material itself. The material used to make a product, together with the fabricating, machining, and processing, adds substance and value to the item, but all that the handling does is to increase its final cost. Only lately have we become aware that this phase of our industrial procedure, if not closely controlled, can make our products so high-priced that our competitive position is endangered.

Because, since the very beginning of our industrial life, materials handling has been looked upon as a necessary evil, we have accepted it as such and proceeded to bury its cost in the overhead burden or include it along with other operations That this is wrong we are only slowly beginning to realize. Scarcely a manufacturing operation is performed today for which the actual man-hours required are not known. Why, then, should we not apply this analytical searchlight to materials handling. We have gone to great lengths to find out what our drilling, turning, milling, painting, and other operations cost so that we can price our products properly. We are seeking constantly how to reduce these costs, yet the handling of the product between these same operations has been entirely overlooked or only given a passing thought.

When a study is made of the manufacturing cost of a product with the object of reducing its cost, nothing is overlooked, that is, nothing except the handling. We go to considerable lengths to gather data concerning engineering, design, manufacturing methods, and other related factors. All these are analyzed to the last degree. We consider changes in the basic design, the possible substitution of other materials, new methods of processing, use of new equipment, combining or eliminating certain parts, new finishes, and, in short, everything that will affect the final selling price. We want to stay in business, hence our concern over cost; yet, per dollar invested in the changes we may decide upon, probably none will give us as great a return as some of the improvements which can be made in handling materials from operation to operation.

This statement is made deliberately because only too often have we thought of materials handling as that phase of our problem relating to the receipt of goods and their shipment to market. But what of the problem between these two points? It is the handling here, sometimes done as individual pieces or in bulk, which has added so much to the cost of our product but nothing to its value.

For the moment, let us revert to the matter of cost reduction, particularly with the thought of exploring ideas which may affect handling of materials during the manufacturing cycle.

Since we all recognize the fact that we can sell only that which has value, then it must be admitted, we cannot put into our product anything which does not add to its sales possibility. This brings up the question, "What are some of the things to look for in the manufacturing process which might be reduced or eliminated?" Industry in general agrees with the broad statement that from 10 to 80 per cent of our manufacturing cost is materials handling. Obviously, here is a fertile field for cost reduction which should pay big dividends.

Let us mention a few of the items to consider, when making a manufacturing operation analysis, which have a direct relation to materials handling and the cost of a product.

ANALYZING THE MATERIALS-HANDLING PROBLEM

If the material to be handled is fragile, can a more substantial material be substituted so that its handling may be speeded up? Changing to a lighter material would definitely reduce the problem.

A reduction in the thickness of the material might also help.

A change in design could have a number of beneficial effects.

A restudy of tools and dies used in the forming processes could reduce materially the number of moves required.

An example of this last item was recently demonstrated in one of our plants. In a metal-forming department, an average of 28 loads of material were received daily by each group. One of the groups performed four punching and forming operations on each piece. Thus, the 28 loads received were the equivalent of 112 separate loads. If, through a study of the basic design of the product, the dies could be redesigned, and the operations reduced to 2, we would only handle 56 loads of material. Reducing this to dollars and cents, we found that a machine setup was made every other day; therefore, we saved 125 setups yearly at $15 each per machine or $2 \times 15 \times 125$ for a total savings of $3750 for setups alone, and at the same time 2 handling operations were entirely eliminated. Add to this the operator's time saved and a very substantial figure results. Furthermore, we increased the available productive hours of the equipment and produced a better product all through the study of materials-handling costs.

EQUIPMENT CHANGES IMPROVE PRODUCTION PROCESSES

A big stride toward reducing handling costs can be made by the introduction of automatic or semiautomatic equipment. Two specific cases in one of our plants demonstrated what can be accomplished in this direction.

Fig. 1 shows the old method of coremaking. Cores were made by hand on the benches shown in the upper right from sand prepared on a balcony floor above. The sand was dumped in a hopper to the floor below; here each coremaker got his own supply, made up his cores and stored them in temporary racks. From this point a material handler arranged them on sorting racks and then transferred them to a drying rack which was pushed into the batch ovens. After the cores were seasoned properly, they were removed, blackened, and taken to storage.

In contrast to this, we installed the new layout shown in Fig. 2. In this layout, the entire method of making cores was changed, as well as the handling system. Sand is now prepared in an area adjacent to the coremakers' benches on the

Contributed by the Materials Handling Division and presented at the Annual Meeting, Atlantic City, N. J., December 1–5, 1947, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

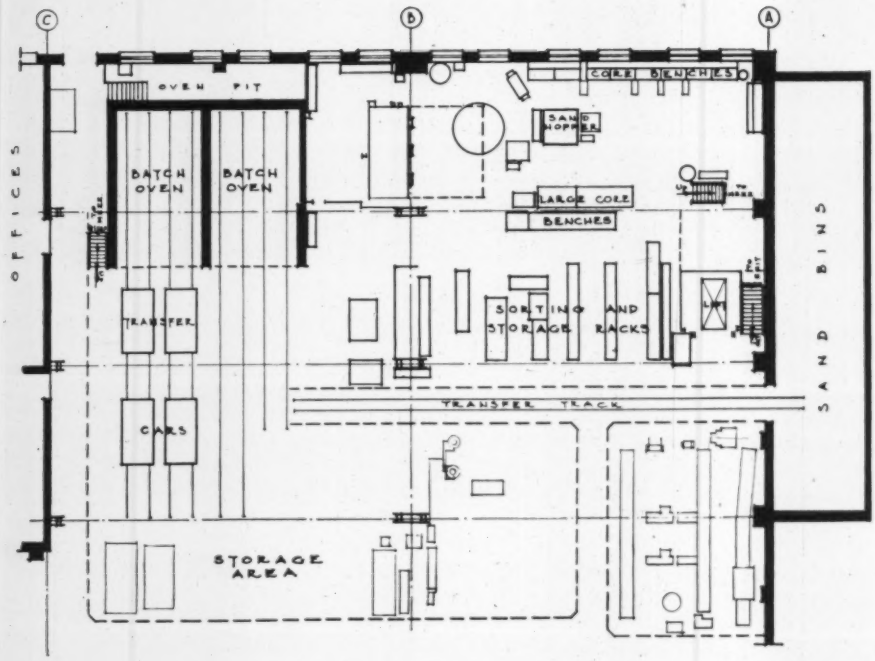


FIG. 1 LAYOUT OF OLD CORE-MAKING ROOM

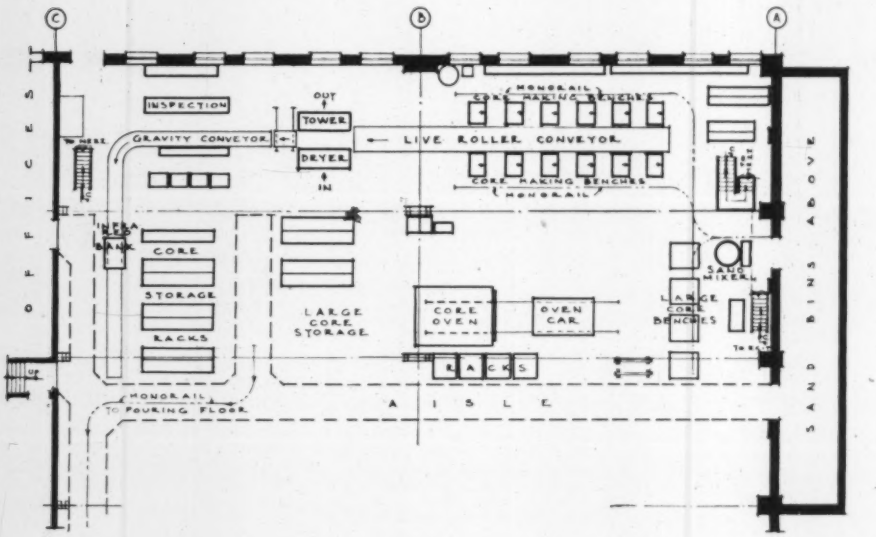


FIG. 2 NEW LAYOUT OF CORE-MAKING ROOM SHOWING HANDLING SYSTEM

main floor. An overhead monorail supplies the coremakers who use the latest coremaking equipment. Each coremaker fills a pallet with completed cores and then places it on a live roller conveyer. This conveyer takes the pallet to a drying tower where a material handler places it on a continuous vertical chain elevator. The cycle is so timed that when the cores come out the side, they are ready to blacken and are sent through an infrared bank, then to storage.

TABLE 1 COMPARISON OF MATERIALS-HANDLING COSTS FOR CORE DRYING

Old method: Manual handling in and out of old type batch ovens.
New method: Complete mechanization from coremaker to storage. Either method requires service of one material handler.

Items	Old method	New method
Total handling elements	20	3
Pallet loads produced daily	185	750
Daily elapsed hours	5.6	5.6
Handling time per plate, hr	0.0304	0.0075
Coremakers in group	7	16
Cores produced per man	26	46

Total production increase of new method, 405 per cent

Table 1 shows what can be done to cut handling costs in a manufacturing cycle such as this when the entire process is analyzed and a completely new method set up.

On the other hand, let us consider an example of what can be done when the method is not changed but only the handling between operations.

Fig. 3 shows a grid-grinding activity where each operator, after performing his particular operation, places the grid on a four-wheel dolly with box sides. When it is filled, he pushes the container over to the next operator, and so on to the packing and shipping area.

A new handling system for this procedure is shown in Fig. 4. The position of the equipment is not materially changed. A monorail for bringing the grid castings from the shakeout to the first operation has been provided. From there a system of conveyers, on which pallet loads of the castings formerly sent

TABLE 2 COMPARISON OF MATERIALS-HANDLING COSTS FOR GRID FINISHING

Old Method: Grinders carried box loads of grid to next operator.
New Method: Grinders placed grids on pallets, sent them to next operator by gravity roller conveyer.

Items	Old method	New method
Grinders in group	3	3
Grids produced per 8 hr	400	464
Total time per grid, hr	0.020	0.0173

Total production increase of new method, 16 per cent

from operator to operator by gravity roller conveyer, has been installed. This completely eliminates the need for the operator to move the material to the next station. What these changes accomplished is shown in Table 2.

If the manufacturing analysis contemplates combining parts, the materials-handling problem will certainly be aided. Although the new part may be increased in size and weight, a savings will be realized since fewer parts are to be moved.

Then, too, a careful study of the finish might bring about a change so that the part will not require unusual care in handling.

A reduction in the number of operations, of course, will reduce the handling proportionately.

A change in the sequence of operations may reduce the number of handlings or the distances moved.

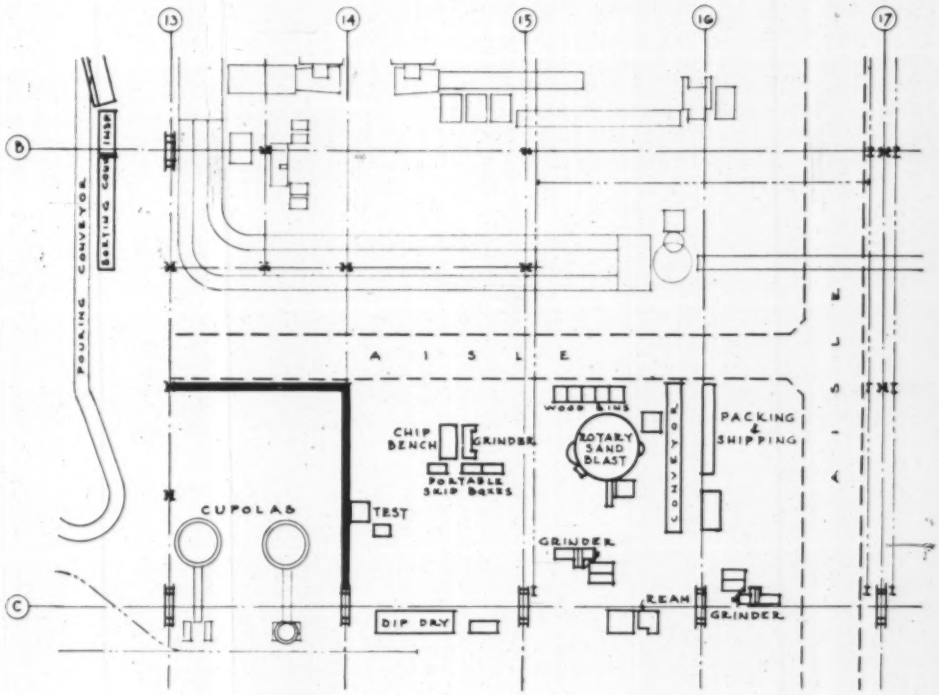


FIG. 3 LAYOUT OF OLD GRID-GRINDING ROOM

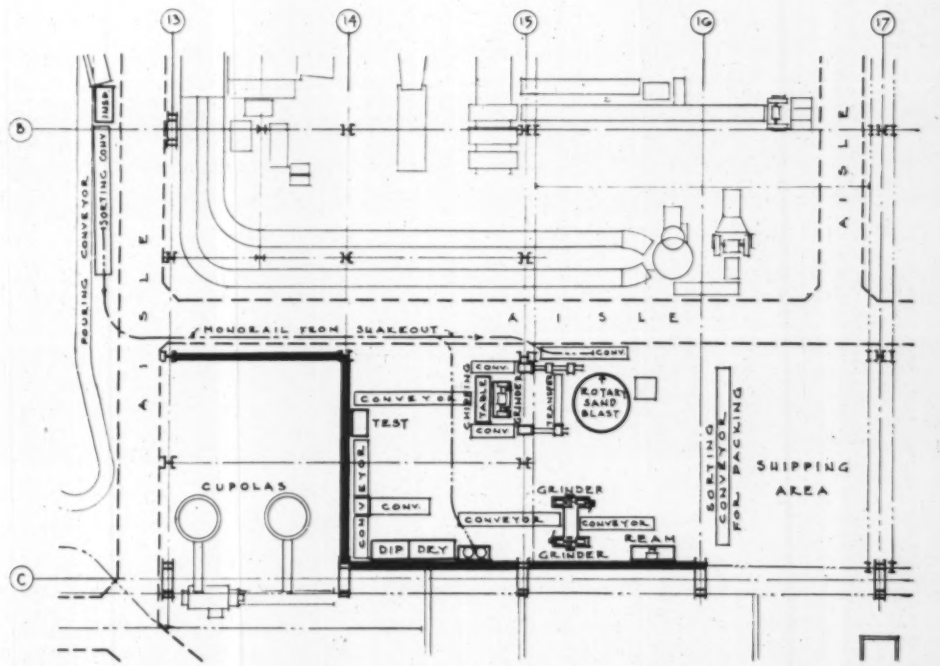


FIG. 4 NEW LAYOUT OF GRID-GRINDING ROOM SHOWING HANDLING SYSTEM

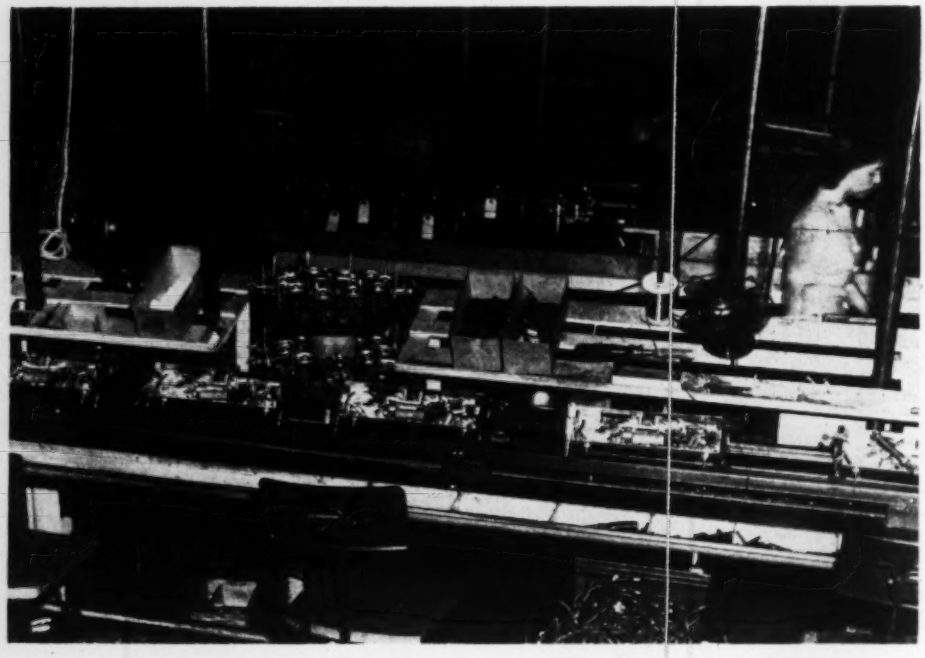


FIG. 5 TRACK AND POSITION SYSTEM APPLIED TO RADIO-CHASSIS ASSEMBLY

These, as in the case of any of the elements considered in a manufacturing operation analysis, are but a few of the possibilities to think about when analyzing the individual materials-handling problems. The thought should be stressed that both the manufacturing method and the product itself should be analyzed for handling improvements.

After the quantity, design, material, methods, and operations have been established, there are numerous handling operations which should be studied.

BASIC IMPROVEMENTS IN MATERIALS HANDLING

The basic materials-handling improvements required before and after each operation may be considered as follows:

1 The part or material is moved to location.
2 Placed in temporary storage or laydown.
3 Moved to machine or work station.
4 Operation performed and moved to temporary storage.
5 Moved to next location and cycle repeated.

It may be said, "We don't do all that handling in our plant." However, it is likely to be so, unless someone has recognized the situation and has done something about it.

When manufacturing any item, it will be found that numerous operations are performed on it. The average is probably 5. Multiply this by the number of items made and then multiply by the number of moves at each operation, and the result is a sizable handling job. To illustrate this point from another

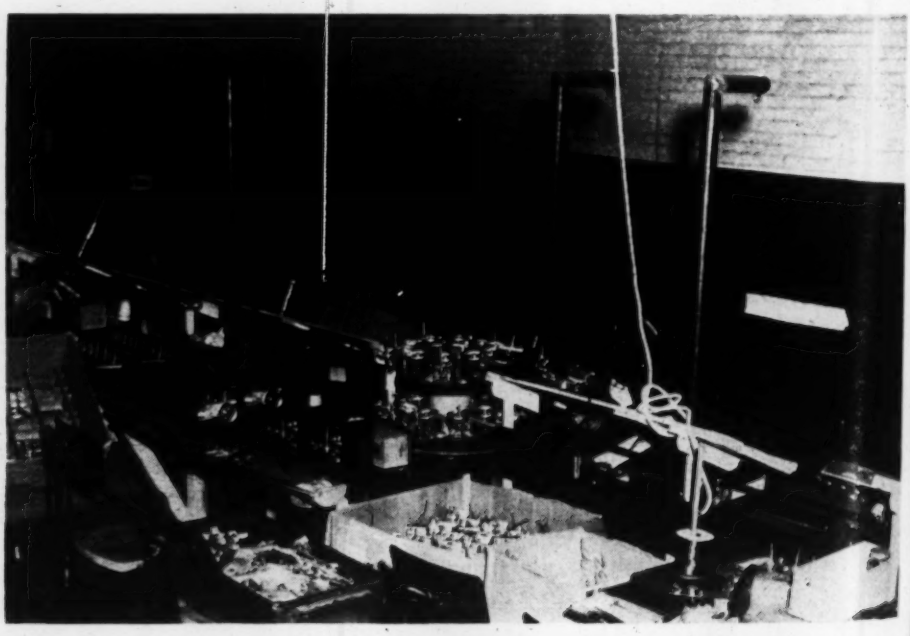


FIG. 6 SUBASSEMBLY STATION DIRECTLY BEHIND WORK POSITION SHOWN IN FIG. 5

aspect; multiply the weight of each piece by the number of pieces times the number of moves made and it will be discovered that some real tonnage has been handled. Now compare this total weight moved to the total weight of material received in the plant and it will be seen that a ratio as high as 150 to 1 of material handled to material received has occurred. Does that still leave one satisfied with the job being done? It must be remembered that all this handling has not added one cent of value to the product but has certainly done something to the cost.

With the number of handlings and the total man-hours involved being greater than the operations performed in most plants, the need for a thorough materials-handling analysis is obvious.

The old adage, "The part least handled is best handled," is a good one to remember and, of course, no handling would be perfection. But perfection in materials handling, like perfection in anything else, is seldom attained. Any accomplishments toward this end can only be achieved by constant and careful analysis of all the factors involved.

The dictionary gives the following definitions.

"Material"—that of which anything is composed or may be constructed.

"Handling"—the act of touching or turning with the hands. Fingering. Manipulation.

In this act called "material handling," is it possible we are adhering to the definition? In any event it will be agreed that we are still doing a lot of our work manually, or the costly way.

HOW A RADIO ASSEMBLY LINE FUNCTIONS

With the ultimate goal of no handling or the least handling possible in industries with high volume of repetitive products, great strides have been made toward this end, as, for example, the radio assembly line shown in Fig. 5. In this view, we see radio chassis proceeding down an assembly line. Note the complete absence of conveyers. Contrary to popular belief "conveyerization" is not always the answer. It was found, after an intensive study of this operation, that a chassis could be passed from operator to operator faster and more easily if it were pushed along a track and properly prepositioned for the operator, rather than removing it from a conveyer, performing the operation and then replacing it on the conveyer. On this line a specially designed carrier on ball-bearing wheels, riding in a track, holds the chassis in position and enables the operator to push it down to the next work station. Provision for balancing the line was made by allowing one chassis to stop between each operator. Note the merry-go-round arrangement near the center of the view. Tuning condensers made on a subassembly bench behind the line at this point keep the operator properly supplied.

Fig. 6 is a view taken directly behind the work station shown in Fig. 5. It should be pointed out that parts received from the suppliers are taken directly to the assembly stations by a material handler without being removed from their original carton. This is done wherever possible for each day's production requirements throughout the entire layout. The parts are then made into subassemblies and fed directly to the operator for installation in the chassis. Thus, handling operations are reduced to a minimum.

Fig. 7 shows another merry-go-round arrangement where the supplier's cartons are placed as received. As the chassis comes down the line, the operator reaches into the box, removes the proper tubes and places them in the chassis as it goes by. From here the chassis proceeds to the first of a series of test stations by conveyer.

Early in the paper mention was made of moving pallet loads of material from operator to operator. This is known as "unit load" and reduces considerably the per-item cost of handling. Although this is an ideal way of moving material, our products and method of assembly do not always adapt themselves to this method. The radio assembly line is one example where equally great handling-cost reductions were possible by moving individual items. Only through an intensive analysis of all factors involved can we decide the proper way to move things.

CONCLUSION

This matter of handling materials presents to industry the greatest opportunity for cost reduction available today and constitutes a real challenge to our ingenuity. The answer is neither easy nor simple, but, by applying sound principles of manufacturing analysis and good engineering practice, we will bring about the desired results to the ultimate benefit of everyone.

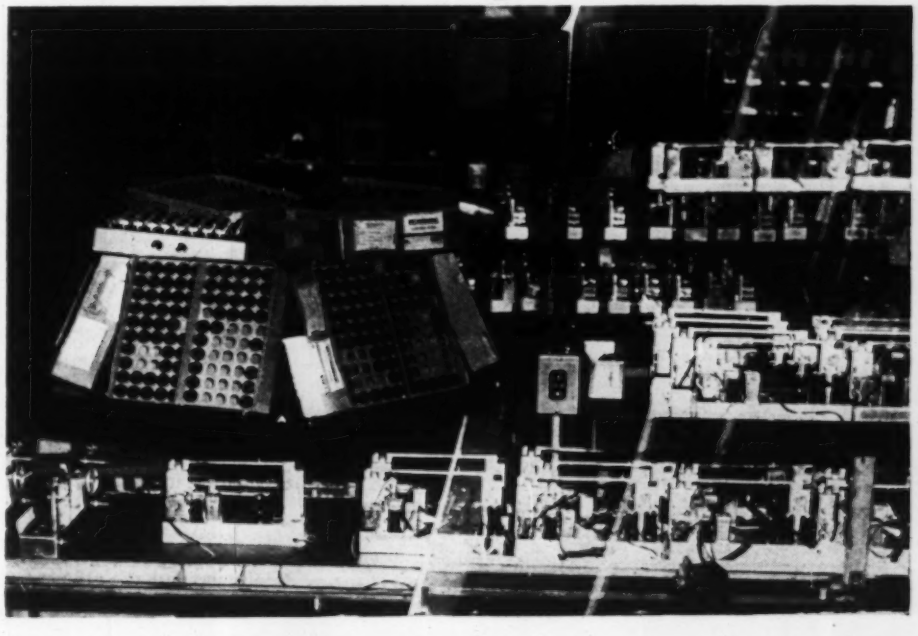


FIG. 7 TURNTABLE ARRANGEMENT FOR STOCK OF TUBES IN CARTONS FROM WHICH OPERATOR CAN SUPPLY RADIO CHASSIS AS IT PASSES ON ASSEMBLY TRACK

MATERIALS *and* POWER

By CLYDE WILLIAMS

DIRECTOR, BATTELLE MEMORIAL INSTITUTE, COLUMBUS, OHIO. MEMBER A.S.M.E.

AMERICA'S position of world leadership, attained in such a short period since the founding of our nation, has been due in no small part to our vast storehouse of mineral resources, and the wise use of them by our engineers.

Man has always striven to release himself from dependence on his own muscular energy and that of other animals. He first used his ingenuity to employ the forces of wind and flowing water. He next learned how to burn fuels and generate mechanical power. Then the great industrial revolution was on.

As a result, in the United States we have a capacity of approximately $1^2/_3$ billion hp, in the form of power plants, automobiles, locomotives, aircraft, and steamships. This is about $11^1/_2$ hp per inhabitant. Assuming the average worker can exert about $^1/_{20}$ hp, this means that every person in the United States has constantly at his command the equivalent of 230 slaves.

DEVELOPMENT OF POWER RESOURCES

Historically, the development of our power resources, and hence of our industrial economy, may be divided into three major periods. The first, lasting from shortly after the Civil War to the end of World War I, was a period in which there were many basic inventions. These were extensively developed. The second, extending from World War I to the beginning of World War II, was characterized by the intensive development of inventions, that is, there were important though not revolutionary changes. The third and current period, which began with World War II, promises to be one in which both intensive applications of old inventions will be made, and new basic conceptions also will be forthcoming.

Prior to the Civil War, man had experienced some release from dependence on the natural sources of power. He had the steamboat, the railroad, the cotton gin, the harvester machine, and the telegraph. But these were not generally available or highly developed. After the Civil War came the electric lamp and the development of electric generators, the central power station and effective methods of transmission of electricity, and the telephone. Then in succession came the automobile and the airplane. These inventions were applied to commercial use. Our railroads were extended from coast to coast. The Bessemer and open-hearth steelmaking processes came into being and made possible cheap steel in plentiful supply. The large easily mined Lake Superior deposits of iron ores were brought into production. Our porphyry-copper and other metal mines were developed as large-scale operations. Petroleum was produced in large quantities and refining methods were developed to make low-priced fuels and lubricants.

All these activities were put into effect hurriedly and on a large scale. There was little time for refinement. The conception of the radio was at hand and the heart of it, the vacuum tube, was developed. However, perfection of the device had to await the second period, beginning after World War I. This first period of expansion required the application of engineering on a vast scale. Such application of science as there was consisted largely of the cut-and-try woodshed variety. Industrial research, except in relatively few cases, was just beginning to be organized on a businesslike basis. This was left for the next period.

This next period was characterized by the application of engineering and science to our industrial life. The efficiency of operations was improved, costs were reduced, and the quality of products was enhanced. As a consequence, luxuries became necessities.

LARGE-SCALE INDUSTRIAL RESEARCH

During this period, organized industrial research was developed on a large scale. Large, wisely managed, central research laboratories, excellently equipped, and staffed with skilled workers, came into being. The annual expenditures for applied research rose from a relatively small amount to between $250,000,000 and $300,000,000, employing 50,000 to 60,000 persons. Methods of research of proved value were developed; engineers became proficient in the application of results of research and began to demand better and better products. Industry and finance came to realize the value of research and technology and made intelligent use of them.

Thus as we entered the third period at the beginning of World War II, we were ready with this great new resource, research. Although we had not directed our research and technology as Germany had done for 20 years, to wartime purposes, we were ready physically and psychologically to do so quickly. This we did with remarkable success.

Through the development of improved materials and of more efficient production processes, we were able to manufacture enough guns, tanks, aircraft, radar, and other weapons of quality in time to beat Germany at her own game. To cap the climax of this great achievement, we did the fundamental and applied research and built plants to produce the atomic bomb. In doing so, we expanded our research activities by approximately three times. Research scientists and engineers learned to make short cuts, to overcome almost insurmountable obstacles, and to co-operate unselfishly with other scientists, engineers, and industry. They acquired courage to tackle revolutionary conceptions as their successes gave them a new confidence. Industrial management worked closely with the scientist and engineer, and applied results quickly. Government research grew phenomenally, until by the war's end, the total government and industrial research effort reached a volume of over $750,000,000 a year. This growth has continued until now Government and industry spend more than a billion dollars a year for research and employ 200,000 people.

Thus, during the last war, we entered the third period of our industrial economy, which may be characterized as one embracing both extensive and intensive development of invention—a period which combined the important phases of the first two. Revolutionary inventions and conceptions are coming fast, and they are being applied effectively by our highly developed research organizations.

MORE EFFICIENT USE OF MATERIALS NECESSARY

Because of the tremendous drain the war made on our reserves of metals and fuels, some people fear that our present

Address presented at the Fall Meeting of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS in co-operation with the Utah Section of the American Institute of Mining and Metallurgical Engineers, Salt Lake City, Utah, Sept. 1–4, 1947.

volume of industrial activity cannot be continued, that our growth rate cannot be sustained. While it is true that great inroads have been made, especially in our rich metallic ores and petroleum, present-day technology is so advanced and our research facilities so excellent that they will overcome these shortcomings. Increased efficiencies in the combustion of fuel, improvements in the design of furnaces, the use of stronger metals and lighter structures—all serve to give additional utility to existing raw materials. Furthermore, research will show the way to still further economies in the use of fuels and metals and will aid in the discovery of new rich sources of supply, in the development of methods to treat low-grade now unusable deposits, and in finding ways to substitute plentiful for scarce raw materials.

Moreover, as the diminishing supplies of rich metallic ores cause an increase in relative price, research will find new higher-priced uses for them. We are experiencing this already with copper, lead, and zinc. It should hold generally for other metals and fuels as well.

The development of large-scale production of oxygen in relatively pure form is destined to open new opportunities for conservation of petroleum. Already plants are under construction for the synthesis of gasoline from natural gas, and substantial research is under way to produce liquid and gaseous fuels from coal and oil shales. The availability of large amounts of cheap oxygen may also revolutionize many metallurgical and chemical processes. Important work is already under way for utilizing oxygen in the production of steel and pig iron.

These few examples are convincing evidence that we will have enough materials to supply the constantly growing requirements of this power age. The requirements will not only grow; they will change in character constantly.

From the development of James Watt's first engine to the jet plane of today, the story has been the same. The engineer designs for better performance. This requires materials to withstand the resulting more severe conditions, or improved fuels to take advantage of the improvements the new design makes possible. The metallurgist and chemist make them available.

TEAMWORK BETWEEN ENGINEERING PROFESSIONS

Recognition of the interdependence of the engineer, the metallurgist, and the chemist, and their excellent co-operation through the years to achieve one success after another, should be an inspiration to all. The recent development of improved metals to resist increased temperatures in both stationary and mobile power plants is an excellent example of this co-operation. It also shows how the organization of a closely knit group, working unselfishly for progress, can act as the stimulus for great accomplishments.

In May, 1924, a symposium on high-temperature metals was held in Cleveland in connection with a meeting of this Society. Engineers and metallurgists summarized the knowledge then available on the requirements for metals for use at elevated temperatures, and on the properties of metals available for this purpose. This symposium resulted in the formation of the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M. Through its work of correlation and publication of information on properties of metals and methods of testing for high-temperature service, it has been the means of effecting co-operation between the engineer and metallurgist. It also has stimulated research and directed it into practical channels. Much of the rapid progress that has been made during the past 20 years in the improvement of the high-temperature properties of metals can be credited to the stimulus and guidance of the work of this committee.

For some time prior to our entrance into World War II and during it, two major research programs similarly contributed to a better understanding of the problems of high-temperature service and to progress in getting better materials. These were sponsored by the National Advisory Committee for Aeronautics and the Office of Scientific Research and Development. In these programs, which were wisely co-ordinated to make them complementary to each other, research and testing projects were carried out in all of the university, research-institute, and industrial laboratories having specialized facilities for this type of work. Two large committees, made up of the nation's best specialists in the production and application of high-temperature materials, worked diligently in consultative capacities. The project was wisely directed by representatives of the sponsor agencies working in close co-operation with the Army and Navy.

Similarly, in England, the National Physical Laboratory, an agency of the British Government, carried on much useful work in this field. Its work was closely co-ordinated with the interests of various British military agencies.

These widespread co-operative activities resulted in an increasingly better understanding of material needs and appraisal. They resulted also in a large research and development program by industry. With such a broadside attack, it is no wonder that great progress has been made. This progress has been most apparent in recent years in the development of better aircraft, which have constantly demanded higher strength-weight ratios and higher operating temperatures of critical parts of their power plants. Improvement in stationary steam power plants has also been outstanding, and the work in this field has served as the basis for developments in gas turbines.

POWER ADVANCES WITH IMPROVED METALLURGY

In 1924 stationary power plants operated usually with steam under pressure of 350 psi, some going as high as 600 psi. A temperature of 750 F was considered the maximum for safe operation, because the steel then in use for piping showed considerable loss in strength at 600 F. Gradually, requirements have been increased and today one steam power plant is being built to operate at 1000 F and 1250 psi. Another is expected to use piping at 1050 F to 1100 F and under stresses of 1800 to 2500 psi. To resist the high stresses, the corrosion effect caused by such high temperatures, and the tendency for steel to become weakened by graphitization, it is necessary to use alloy steel ($2^1/_2$ per cent Cr, 1 per cent Mo). If still higher temperatures are used, it probably will be necessary to resort to the more expensive highly alloyed austenitic stainless steels.

The steam locomotive has operated under conditions not requiring such high temperatures and pressures. Advances that have been made in this field have come from the design of larger boilers, the adoption of stokers, and the use of poppet valves. Unfortunately, it must be said that progress has lagged in the locomotive field because of failure to adopt the water-tube boiler and thus make available the advantages of higher pressures. In fact, the full use of present metallurgical knowledge would permit at least a moderate increase in pressure with the conventional firebox boiler. Formerly, boiler pressures of 200 to 225 psi were not exceeded. The advantage of the use of higher pressure is so great that recent designs have called for 300 psi. The steam temperature at this pressure is still below 500 F, which presents conditions readily met by steel. Hence opportunities for going to higher pressures and temperatures are good, especially in view of the availability of better steel alloys and improved fabrication methods to avoid boiler embrittlement and other difficulties.

For the most part, Diesel engines both for stationary plants

and electric locomotives continue to utilize conventional materials skillfully applied.

The automobile engine, except for the exhaust valves, has not required the use of materials at excessive pressures or temperatures. The industry, however, has skillfully developed the use of conventional materials. In the development of reciprocating aircraft engines, aluminum alloys have played an essential part. Magnesium-base alloys also have been important for weight-saving purposes. In both instances, improvement of the strength of these light alloys at high temperatures has been necessary. As in the case of the automobile engine, exhaust valves and exhaust-system ducts must be made of highly alloyed materials. The exhaust valves and associated parts must resist temperatures up to 1600 F, but the stresses are not great. Thus the problem of finding materials to withstand both high temperatures and high stresses did not arise until the advent of the gas turbine.

The gas turbine, however, would not have been possible without the highly alloyed materials resulting from metallurgical research during the last 5 to 10 years. At operating temperatures of 850 to 900 F, a gas turbine will show zero efficiency. In this range of temperature, the power output of the turbine is completely absorbed by the compressor which supplies air to the combustion chamber. Materials to withstand high stresses and temperatures above 1000 F, i.e., 1350 to 1500 F, had to be developed. Competition soon made the upper figure imperative. Now engineers are pushing upward beyond this figure and are asking for materials to withstand 1600 F and stresses as high as 20,000 psi.

METALLURGICAL RESEARCH PAYS OFF

During the 15 years before World War II, search for better metals for steam plants, oil-refinery-still tubes, exhaust parts of piston engines, and exhaust turbosuperchargers had developed a large group of research workers and a vast body of knowledge of high-temperature alloys and test methods. When war demands required the rapid development of alloys for gas-turbine parts we were ready. Thanks to the skill of the design engineer and the success of the metallurgist, the aircraft industry was able to supply the superchargers for the engines of high-altitude fighters and bombers and the gas turbines for our jet planes which became useful toward the end of the war.

Supercharger-disk materials must withstand a temperature of 1100 F under high stress. For this purpose, chromium-nickel-cobalt-iron alloy, strengthened with such other elements as molybdenum, tungsten, columbium, or titanium, is used. One ferrous alloy used for disks contains 16 per cent chromium, 25 per cent nickel, and 6 per cent molybdenum. The gas-turbine blades used in superchargers and jet engines are subjected to temperatures of 1500 to 1600 F, and the metal, itself, sometimes reaches a temperature of 1500 F. To secure stability, still more highly alloyed materials must be used and some are practically iron-free. The strongest materials suitable for precision casting are the cobalt-base alloys containing 40 to 70 per cent cobalt and such other additions as chromium and molybdenum or chromium, nickel, molybdenum, tungsten, and columbium.

Another series of alloys, based on chromium, with upward of 50 per cent of this metal, is showing great promise. An example is one that contains 60 per cent chromium, 15 to 25 per cent molybdenum, and the balance iron. This alloy must be melted and cast in a vacuum. In preliminary tests it shows up better than the cobalt-base alloys and gives promise of permitting safe use of still higher stresses. There is much hope also that other alloys will be forthcoming which will have better properties than the present ones. Those metals offering promise, in addition to chromium, are titanium, columbium, tantalum, molybdenum, and tungsten.

The gas turbine has met with so much success in aircraft and the opportunity for securing metals to withstand high temperatures for long periods of time is so promising, that this means of power generation will be extended to numerous other fields. Gas turbines to swing aircraft propellers are under development. Three gas turbines for ship propulsion are being constructed for the Navy and the Maritime Commission. Stationary power-generation units run by gas turbines of 5000 to 10,000 hp are in the planning stage. The gas turbine may be expected to compete with the Diesel in railway transportation, since it offers similar advantages. A group of railway and coal companies is sponsoring the development of locomotives powered by gas turbines which will use coal instead of oil as fuel. Engineers are studying the possibility of utilizing small gas turbines in place of the larger piston engines for large trucks and buses. The high efficiency and the simplicity of construction of the gas turbine and the use of cheaper fuel will insure much progress.

MODERN DEVELOPMENTS IN FUEL PRODUCTION

Whereas heat-resisting metals present the critical material problem in the gas turbine, fuel is the all-important consideration in the automotive and aircraft piston engine.

Until 1920, and the advent of the oil-cracking process, the best fuel available for both automotive and aircraft engines was gasoline obtained from oil by simple distillation. This gasoline consisted essentially of those hydrocarbons originally occurring in the petroleum. By means of the cracking processes, new hydrocarbons or larger amounts of those originally present in but small quantities were produced, and these made possible the attainment of greatly increased efficiencies in engines designed for them. Thus it was that the fuel chemist gave the engineer the opportunity to increase compression ratios in his engine and to demand gasolines of higher and higher antiknock values.

Developments in the aviation field have been spectacular. If engine performance of gasoline used in World War I be given a rating of 40, then the fuel used in World War II had at a maximum a relative performance of 200. Processing of petroleum products in the refinery, using high temperature with high pressure or with catalysts, made the gasoline used in World War II $2^1/_2$ times as good as that in World War I. The $2^1/_2$ was doubled by adding oil-soluble antiknock materials and by using water and alcohol injection.

In 1920 motor gasolines had a relative engine performance of about 40. As a result of developments similar to, and in some cases identical with those used for aviation gasolines, motor gasolines with a relative engine performance of 100 can now be produced, and may be on the market in 2 or 3 years. In the case of the high-compression car produced and recently described by Mr. Kettering, a gasoline having a relative performance of about 100 is necessary. In this case, however, skillful engine design gives this performance from a gasoline which would only have a relative performance of 70 in older style engines. Gasolines of the type necessary for the high-compression car would produce no significant improvement in performance in present cars, and such a use would represent a waste of both money and the country's petroleum resources.

This account of progress could not have been written were it not for the diligence, ability, and co-operative effort of the engineer and the materials research scientist; the engineer with his imagination, skill, and practicality, the scientist with his fine laboratories and proved research procedures, his background of knowledge, and his eagerness to improve his products. Progress in such large engineering developments feeds

on progress. Surely the past few years have given much sustenance for the continued improvement of our forms of power generation. Judging from the tremendous advancement made during the war, using the present status of materials and power as a basis, the potential possibilities for the future are simply staggering.

FUTURE POWER DEVELOPMENTS

The speed record of 650 mph recently established by one of the Navy's jet-propelled "Skystreak" planes is pushing closely the velocity of sound (760 mph at sea level). Promising as is the development of turbojet-powered devices, increasing attention is being paid to propulsion by rocket engines.

The German V-2 rocket bomb was propelled at the speed of over 3000 mph. It received its propulsion from a rocket engine burning alcohol and oxygen which it carried in liquid form. This form of power generation has greater force than is obtained with the turbojet engine, which relies on the combustion of oil or gasoline in compressed air taken from the atmosphere. Furthermore, other chemicals may be used which will give the rocket engine still greater propulsive force.

The rocket engine already has been of practical value in jet-assisted take-off of aircraft, and it is now being made the constituent part of air-borne vehicles designed to travel faster than sound. Since the rocket engine does not rely on the oxygen of the atmosphere for combustion, as does the turbojet engine, it could be designed to pass above the earth's atmosphere. If sufficient force could be developed to generate speeds above 25,000 mph, rocket propulsion would offer the promise of vehicles that could escape from the attraction of the earth's gravity and so travel through space.

In the same speculative Jules Verne category may be placed proposals to operate supersonic vehicles with energy derived from atomic fission. While such ideas make interesting speculation, practical work is now under way involving the generation of steam and electric power from atomic energy in stationary plants. In such plants heat is generated by the conversion of matter to energy. This heat is transmitted to heat exchangers and the resultant steam is utilized in a conventional manner. Numerous other schemes occur to make use of this unique source of energy.

Many difficulties will be encountered in the work to make atomic power plants practical. Radioactive fission products must be frequently removed from the uranium and plutonium, and the nuclear reactor must be enclosed in a thick heavy shield to protect personnel from harmful radiation. This makes the problem of atomic propulsion of any vehicle a most difficult one. Ship propulsion is the least difficult because of the possibility of utilizing water as a protective shield.

While schemes for the development of rocket and atomic-energy space ships are left for interesting speculation, active work is under way on the use of rocket engines for air-borne supersonic vehicles. Besides involving the ultimate skill in design of the engine, steering devices, and other controls, their success depends upon our ability to find materials of construction to withstand temperatures hitherto considered beyond the range of engineering materials. Again, skillful design can permit lower maximum temperatures. Without cooling, temperatures of 5000 F and higher may be reached in the engine.

The high-temperature "supermetals" developed for the gas turbine and improvements on these yet to come will be useful, but, to meet the highest temperatures, it will be necessary to use ceramic materials. Materials made from the most highly refractory substances, such as oxides of beryllium, aluminum, magnesium, and zirconium, are the only known materials that will not melt or burn at such temperatures. They may be used as coatings for metals, in structural combination with metals, or as individual parts. One difficulty involving the use of ceramic materials is their relatively poor mechanical properties. These must be improved or compensated for by design.

Thus again progress depends on the materials engineer and scientist—this time the scientist to produce a product of critical importance to the venture, and the engineer to apply it to practical use.

THE MINING ENGINEER'S OPPORTUNITY

These conceptions of new machines, while creating difficult problems for the design engineer and the materials specialist, present for the mining engineer a great opportunity. They will require and may use in large quantities a new and unusual group of metallic and ceramic materials. Such materials, because of the high degree of useful work they will perform and owing to their unusual properties, may command a high unit price compared with customary constructional materials. Thus to the long list of metallic and mineral products which have played so important a part in our national economy, we may soon add a new group, the supermetals and the superrefractories.

Remarkable as progress in the improvement of the old forms of power generation and in the development of new ones has been, it seems certain that it will seem small compared with what the future will bring. Any day now we should hear reports that jet planes have pierced the sonic barrier. From then on there will be rapid progress in attaining higher and higher speeds.

Our military research in the development of high-speed jet planes and rocket-driven supersonic vehicles is a most laudable enterprise, not only because of the benefits which may be expected in a military way, but because of the valuable by-products that will accrue industrially.

These achievements will give us confidence that still greater accomplishments are possible. They will provide knowledge of design and materials that will form the bases for additional accomplishments. The splendid program of the Atomic Energy Commission likewise is providing fundamental and practical knowledge which ultimately will be applied to forms of power generation other than the bomb.

RESEARCH THE KEYSTONE OF FUTURE PROGRESS

The newly found courage, the new knowledge, and our greatly improved facilities for research and its practical application are almost a guarantee that great and revolutionary changes in forms of power generation and transportation are not far off.

The accomplishment of such aims doesn't seem beyond hope of attainment when one evaluates the distance we have gone since the invention of the steam engine and application of electric power, and compares the paucity of scientific knowledge and industrial know-how on which this progress was based with that which exists today.

This dreaming, planning, searching for better power sources and better materials to make them possible is attracting many of the nation's outstanding engineers and scientists. Its revolutionary conception, its tremendous possibilities, and its very magnitude present at once a challenge and an opportunity to the engineer and scientist. It is influencing our educational institutions to teach more of the fundamentals of science. It is a boon to technical societies such as the A.S.M.E. and A.I.M.E. It is encouraging industry and finance to look beyond the horizon of presently available materials and machines.

This dreaming, planning, and searching will keep America strong. It will provide the greatest force there is to lasting peace.

STUDENT COUNSELING

A New Activity for the Local Sections

By A. H. MOREY[1]

CHAIRMAN, ERIE SECTION, A.S.M.E., 1946–1947

IN planning the activities for the Erie Section of the Society in the summer of 1946, serious attention was given to activities which would have three characteristics:

1 Maximum member interest.
2 Maximum member participation.
3 Long-range objectives.

After considerable discussion, particularly with the younger and with the Junior Members, two projects were chosen in such a manner that one would complement the other, and both might ultimately result in a single project. Our first project was the organization of an engineering council in the City of Erie patterned after engineering councils in other cities such as Cleveland, Schenectady, and New York. The second project was vocational guidance of those graduating members of our local high schools who were interested in the engineering profession. We realized at the start that this second activity ultimately would become a function of an engineering council. Since the A.I.E.E. was much interested in both these projects, it was agreed that the two societies would handle them jointly.

A committee was appointed to formulate the constitution and by-laws for the engineering council, and it is expected that these will be ready for submission to the various engineering organizations before the year's end.

VOCATIONAL-GUIDANCE PROGRAM

The vocational-guidance program was discussed with the city school authorities, and as soon as our purpose and aims became clear to them, the project was received enthusiastically. They gave us the utmost in co-operation and help in working out a plan, organizing the program in the schools, and carrying it through.

The plan, as it was finally organized, started with a lecture in each of the several high schools, to which were invited all of the senior students who cared to attend. In the interest of uniformity, all of these lectures were given by one individual and each lecture included essentially the same subject material. There was then an immediate statement by the school authorities that the lecture would be followed up by forming consultation groups of students and a practicing engineer in each of the various fields in which the students thought they might be interested.

In the formation of these groups, we encountered our first major difficulty. In planning the program, we, in our ignorance, proceeded on the assumption that for the purpose of these discussion groups, an engineer was an engineer, irrespective of the handle which preceded the term "engineer." We found, to our consternation, that this was entirely wrong. In the mind of the student who thought he was interested in aeronautical engineering, any other engineer was a dub. He had absolutely no interest in talking to him.

We respected the student's opinion. Officially, we had only mechanical engineers and electrical engineers available but we procured by various means, some of them devious, engineers for these consulting groups who carried the proper handle.

We were very much gratified and pleased at the co-operation which we received from our own members and from nonmembers in getting men for these discussion groups. The engineers appeared to be perfectly willing to make almost any sacrifice or accept almost any inconvenience for what they appeared to consider the privilege of discussion with these students.

In the first of these discussion groups, the questions coming from the students varied over a wide range, all the way from starting salaries to ultimate salaries, kind and degree of training and preparation, requests for recommendations as to particular engineering schools, the engineer's place in industry, and many others. It became necessary to hold meetings of the counselors before the student consultation periods. We were obliged to limit the questions to those which could be answered properly and to provide some uniformity in the answers which were given. One of the difficulties encountered in some groups was a lack of questions. Some conferences degenerated into more or less of a monologue by the engineer.

Lectures and consultation groups were held at five different high schools. The attendance varied at the several lectures, but the total for all five lectures was 980 students.

Engineers for consulting groups were drawn from the following professional branches: Aeronautical engineers, automotive and Diesel engineers, chemical engineers, civil engineers, electrical and radio engineers, industrial engineers, mechanical and designing engineers, plastics engineers, air-conditioning engineers. A total number of 20 engineers consulted with a total of 614 students.

It is somewhat difficult to weigh and judge the net worth of this project. We have had to depend almost entirely on the reaction of the school authorities and on the comments of the engineers participating in the consulting groups. In the opinion of the school authorities, very definite help had been given to a relatively large number of students who were considering engineering as a profession. They were definitely of the opinion that the project was worth while and should be continued and elaborated. The participating engineers reported, in general, a very active interest within the groups, and again, in general, were of the opinion that their time had been well spent.

FUTURE PLANS

In view of the general interest among our members and particularly in view of the interest shown by the city school authorities and the requests for similar programs from other schools in the city and county, a perpetual committee has been set up jointly by the A.I.E.E. and the A.S.M.E. to handle vocational guidance in as many high schools as they can arrange to cover. Eventually, an engineering council or other general engineering body will be in a position to take over this activity. In the city schools, definite plans are being made to fit their curricula to this program. In some cases, the authorities are amplifying the facilities available to the students for orientation prior to their attendance at the consulting groups.

[1] Project Engineer, General Electric Company, Erie, Pa.

Presented at a joint meeting of the Erie Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and the Northwestern Pennsylvania Society of Engineers, at Oil City, Pa., October 2, 1947.

The Habit of COMMUNITY SERVICE

Laying the Foundation of Good Citizenship in a Democracy

By MORRIS LLEWELLYN COOKE

CONSULTING ENGINEER, PHILADELPHIA, PA. FELLOW A.S.M.E.

LIFE in a completely finished world without doubt would be quite boresome. On the other hand it is rather difficult to be entirely comfortable at a time like the present when change for each one of us seems to be the never-relenting order of the day. It has been quite fully established statistically and otherwise that engineers and scientists are less socially minded and community activated than the times and their own interests demand.[1] The emphasis on professionalism and specialism, together with the fascination and absorbing character of the engineer's work, is in large measure responsible for building up our particular kind of ivory tower. However explained, the great majority of scientists and engineers are increasingly separated from the life of the community and especially from its politics with the result that these technicians are hardly ever the types of well-rounded citizens upon which our social system must depend, and also the community, including its politics, misses the leavening influence of large groups of well-educated people. With men and institutions everywhere being forced to assume new responsibilities, we face the necessity of abandoning our detachment from the details of community life and of changing man, the engineer, into man, the citizen and engineer. Apparently this cannot be accomplished without making one radical and rarely discussed change in the education of the engineer.

COMMUNITY INTERESTS BEGIN AT AN EARLY AGE

It is a part of the American tradition that childhood also has its responsibilities beginning in the home and at even an early age developing into community activities. At 83, Josephus Daniels recalls[2] that as a boy he had the duty of filling the lamps, keeping the chimneys clean, and trimming the wicks. Many will remember doing errands, arranging rocking chairs, "helping with the dishes," and supplying coal or wood for the fire. In my family, we took turns at making meteorological observations, and at making triturations with pestle and mortar and putting up the resulting powders—my father being a physician.

The transition to unpaid community services was easy . . . I made my start at a very early age by carrying a pail of water toward the head of the firemen's parade. Later, I pumped the church organ, and at 9 years tolled the bell for President Garfield's funeral. In varying degrees in practically every home, individual responsibilities—family and community—are recognized as a part of parental training right up to the time of "going away to college."

A larger percentage of engineering students leave home for their training than do the general run of college students. Hence for this group there is a complete and demoralizing cessation of responsibilities in going to college. The drastic nature of this break between school and college seems to make it potentially more disturbing to the individual, and the community as well, than are other milestones such as joining the church, coming of age, marriage, graduation, or taking one's first job.

The answer seems to lie in providing the freshman with new types of responsibilities to take the place of those laid down on leaving home, and thus secure for him a new and stabilizing orientation in the life of the community. It is not suggested that either classroom or extracurricular campus activities should be neglected, rather that the college world should not stop there. If teacher and student alike could spill over into the activities of the outside world, breaking down what has become an anachronistic barrier, the college world itself might gain a new vitality.

At a time when 18-year-olds are likely to be subject to military service and therefore are liable to serious injury and even death for the national welfare, logically, they may be considered mature enough to have a voice and a hand in community activities less serious than warfare but socially just as important. Showing that our ideas in such matters do change, I recall that, up to about 30 years ago, members of this Society were not allowed to vote in the Society elections until they became 30 years of age.

Of course there is nothing to be gained by ignoring the fact that the urge to succeed as individuals, both in reputation and in financial standing, takes overwhelming precedence in the average young man's mind over his sense of obligation to the community. This emphasis accounts in no small measure for the rapid industrial growth of the United States to the first power among nations. But, as may be very properly remarked, at times this growth seems to rest upon a very slender foundation of public interest and concern with the general welfare.

ENGINEERS ARE ONLY PEOPLE

After all, a large part of the work of an engineer is dealing with people. People are increasingly organized not merely under governments and in political parties but as in corporations, labor unions, trade associations, and professional societies for economic benefit, and as in churches, in societies, such as Rotary, Kiwanis, and Lions, alumni and community associations, and in fraternal and neighborhood groups for social purposes. These groups and thousands like them run our world. Unless the engineer has accurate information, gained through direct contact as to such groups and their ways, he is apt to move about like a comparative stranger in his world. Many such groups have work they want to get done and welcome volunteers. For the student such contacts make good classroom work more worth while. The infiltration of engineers and scientists into such organizations should make for their improvement as social agencies.

It is my belief that the average college student has matured a bit since my undergraduate days. All hands seem to agree that

[1] "Science Knocks at the Door of American Politics," by M. L. Cooke, MECHANICAL ENGINEERING, vol. 67, 1945, pp. 569–571.

[2] Address at Edison Centennial Celebration, Minneapolis, Minn., February 11, 1947.

the mass infiltration of GI's will leave the college world somewhat more purposeful than before the dreaded incursion.

The solution of this problem of bringing the engineering student and the community together will be more difficult than that of outlining curricula or of regulating intramural activities, because the college authorities influence the extramural world at best in a very limited way. Solutions will vary with each institution because of the differences in the communities in which they are located.

Such outside community activities can be optional or prescribed; they can be supervised either by faculty committees or by student agencies—the latter continuing from year to year in order to build up a tradition of community service. Where faculty members are already overburdened, as is normally the case, it may be feasible to bring in a new and specially qualified individual to plan for, encourage, and supervise community activities. Advocating these activities in the absence of machinery for making them work is not likely to accomplish much. Almost any participation in community life—even in its political life—on the part of an individual faculty member has proved influential.

It is frequently alleged that crowded engineering curricula do not allow the time and opportunity for extramural activities. This is a pedagogical question where those who have the authority will have to weigh the relative advantages of a little less technology and a little more citizenship building before it is too late. Our experience indicates that, once the engineer is graduated, his way to community activity is normally attended with insurmountable difficulties. These first contacts must be made at an age when simple, unpretentious things can be undertaken without a loss of dignity, whether seeming or actual.

Even compensated service in the community, such as, baby-sitting, clerking in stores, entertainer in local affairs, or what-have-you, has its value in bringing the students in touch with the life of the community. Similarly, work directly related to college courses such as power-plant tests, whether compensated for or not, may be desirable. But these are not our immediate concern. It is uncompensated citizen service toward which organized effort should be directed.

The appeals to engineers and scientists without experience in other forms of community life to become active in politics are not likely to prove fruitful in any large way. The desirable type of political activity should grow out of an intimacy with community needs. These contacts afford the seasoning required for high civic purpose and effective political action.

COMMUNITY ACTIVITIES OF UNDERGRADUATES

The following are some community activities in which undergraduates have already participated—some of them doubtless due to the recent inclusion in the student body of the more mature GI's:

In elections, through house-to-house canvassing, registering, voting, and acting as observers at the polls; as members of a labor union, of a volunteer fire company, of a committee for community Christmas tree for the needy, and of a student board of a community swimming pool; as canvasser for various types of drives—Red Cross, Community Chest, Visiting Nurse, scrap, and others; in organizing community dances both to foment community spirit and to raise money for community purposes; in coaching a football team composed of local boys, and acting as scout leader.

One way to discover what is feasible is suggested by the following quotation from a recent letter to the author: "I spent thirty minutes of a class with junior engineering students this morning discussing the responsibilities of citizenship, and we are undertaking to engage each one as an individual in some civic enterprise in however humble capacity. We are planning to have a report from each individual later on in the semester."

One college president writes to me as follows: "One of the types of activity which we feel is more deserving of attention is the work camp. This has been developed by the American Friends Services Committee for summer periods, on a year-long basis, and also for week ends."

A professor of engineering writes: "The ideal is held aloft very plainly by Deerfield Academy in Massachusetts, where my son is a student. He is a member of a potato-picking crew which works as volunteers and without pay to help the farmers of Deerfield, Massachusetts, to gather in their crops. It is a school, which, through its headmaster, Dr. Boyden, has realized the ideal of service to the community to an extraordinary extent."

In addition to the foregoing, the following community activities are possibly open to college students:

Acting as counselor in a boys' club or as an aide in a settlement house, such as Hull House, Chicago, Ill., Henry Street Settlement House in New York, N. Y., or the Light House, Philadelphia, Pa., or as social-service aides for hospitals, family societies, and other welfare agencies, or as orderlies in hospitals. Nursing is another possibility especially in small communities without hospital facilities. Students may well assist in the conduct of surveys for public bodies, such as traffic surveys, particularly in connection with city-planning activities. They can affiliate themselves with farm organizations or junior chambers of commerce, and join other community associations and be active in their affairs. Some types of affiliation with Rotary, Kiwanis, or Lions may be possible. They can read and write letters to and for "shut-ins," and write "letters to the editor" on occasions when issues of public policy are being decided. They can assist in the running of a workers' educational program, act as volunteer craft and hobby directors, or volunteer workers in an industrial recreational development.

STUDENT CITIZENSHIP PROGRAM SHOULD BE NATION-WIDE

If there could be devised some way of bringing about competition in these matters as between different institutions, it would probably act as a powerful incentive to activity, comparable to that which is inseparable from athletic competitions. Some organization, with chapters at many different colleges, by adopting this program could make quick progress. For instance, it is reported that the biennial convention of a prominent senior honorary society having chapters at fifty-two colleges met in Washington last spring and developed a most exemplary program for stimulating community action on each of the individual campuses. I am told that it was a fine group of the top-ranking men from over fifty universities, whose principal interest was in attacking the problems of citizen action in their own campus communities.

It cannot be too frequently reiterated that our democracy is almost in its infancy. To have it survive as the political faith of all humanity in a world torn with manifold highly organized "isms" will require many and radical departures from what have been our lackadaisical customs and easy-going habits. The struggle must be to invent new ways in which an increasing number of people may play vital parts in the management of our democracy. What more important end can there be for education? How can any student spend some of his time more profitably?

PROFESSIONAL ADVANCEMENT IN CANADA[1]

By C. R. YOUNG

DEAN, FACULTY OF APPLIED SCIENCE AND ENGINEERING, UNIVERSITY OF TORONTO, TORONTO, ONTARIO, CANADA

PRIOR to confederation of the Canadian provinces, in 1867, there was so little employment for engineers in Canada that organized attempts to promote the advancement of the engineering profession made but scant headway. The first sustained effort in this direction came with the establishment of the Canadian Society of Civil Engineers in 1887. The Engineering Institute of Canada, with its broader interests and wider scope, has since 1918 carried on and vastly extended the activities of the parent society from which it sprang.

Early in the nineties sustained agitation developed for the constitution of the profession in Canada as a closed corporation, analogous to those of law and medicine. In 1892, Alan Macdougall, one of the farseeing and resolute engineers who had taken part in the establishment of the Canadian Society of Civil Engineers, presented to the Society a notable paper on "The Professional Status." It was a classic. In it were challengingly set out most of the concepts and arguments that still engage the thought of those who concern themselves with the matter at all.

The discussion bore fruit. Drafts of acts for the provincial incorporation of engineers were prepared. According to the terms of the British North America Act, which constitutes whatever of a written constitution Canada possesses, legislation controlling engineering practice is a matter for the provinces rather than for the Dominion. Proceeding in conformity with this, the members of the Canadian Society of Civil Engineers in Manitoba succeeded in obtaining legal recognition of engineering as a profession in that province by the enactment of the Manitoba Civil Engineers Act of 1896. Here, as elsewhere in Canada at that time, "civil engineering" was deemed to comprehend all engineering that was not military. Quebec followed suit in 1898.

Proving difficult of operation, these acts were superseded in 1920 by improved acts administered respectively by the Association of Professional Engineers and the Corporation of Professional Engineers. In comparatively rapid succession all the remaining provinces, except Prince Edward Island, which by reason of its smallness has few engineers, have enacted restrictive legislation.

While marked benefits to the public, as well as to engineers themselves, have been derived from the licensing movement, one undesirable consequence has followed in its train. Far too many young men have come to assume that the only thing lying between them and full professional stature is the obtaining of the legal right to practice. Nothing could be more illusory. There is no assurance whatever that one so equipped will necessarily be accepted by a discerning and critical public as a person fully entitled to the esteem and deference that by common consent are accorded the members of the older and so-called learned professions. One illiterate or boorish licenseholder may offset in the public mind the merits of a score of others about whom there can be no question. The whole profession is compromised by the unacceptable few.

Not enough weight has been given to general education by either the professional schools of engineering or the licensing associations. Two screens in tandem should be placed in the educational and training stream. The first would function as a selective device to insure, in so far as may be possible, that those who enter the professional schools have those humanistic and cultural interests and capacities that must be inherent in one who hopes to be accepted as a member of a true profession. The second should be introduced by the licensing bodies in scanning applications for registration as a check on the effectiveness of the first as an instrument of selection of personnel for educational and professional training and as a corrective if it has failed.

Faculties and colleges of engineering ought to revise sharply upward their general educational requirements for admission, so that the 25 per cent or so of young men who should remain in technical institutes or secondary vocational schools are kept there and are not permitted to impede the programs of the professional schools. Far better work could be done in the latter and the quality of their output made the more impressive if they were not required under circumstances presently existing in Canada to superimpose on true collegiate work the added task of dealing with the area of education that lies between the secondary schools and the universities. Those whose talents and interests definitely belong to this zone are for the most part unpromising aspirants for full professional qualification.

On their part, the licensing bodies should place increasing emphasis on the general educational attainments of those who seek registration. There are still substantial numbers of applicants who base their claims almost wholly on technical knowledge and competency and but little on acquaintance with those things that characterize a broadly educated man. As a result of undue emphasis on the importance of excellence in mathematics and science some men of circumscribed outlook have, unfortunately, slipped through the universities with small evidences of ability to express themselves clearly or correctly in their own language. The proposed second barrier against illiteracy in professional circles could be introduced by the licensing associations through requiring in respect of the graduates of the professional schools a minimum standing in non-technical subjects and through a corresponding test of those who seek registration through examination.

It is unfortunate that some young men look to the professional associations to do for them what only they can do for themselves. Attainment of that degree of public regard that in effect accords to the one that prompts it a vital place in the community wherein he labors, derives from the personal merits of the man himself and not from the bulk or the forcefulness of any organization to which he belongs. One cannot be securely legislated into high places. Professional organizations have a value that is largely limited by technological and economic considerations. They cannot give that quality of understand-

[1] An address delivered at the Fifteenth Annual Meeting of the Engineers' Council for Professional Development, Montreal, P. Q. Canada, October 24, 1947.

ing, that sympathetic man-to-man relationship that determines ultimate acceptability.

EFFORTS OF THE CANADIAN PROFESSIONAL ORGANIZATIONS

It would be unfair to say that engineering organizations in Canada have been unaware of this fundamental principle. They are doing much to raise the quality of the profession by directing into it young men of the highest personal promise and correspondingly by exclusion of those that are unsuitable. They no longer rest their labors on the promotion of technical knowledge and competency. The development of the engineer as a person bulks large in the policies of all of them. No longer is it merely a matter of producing annually an output of human problem-solving machines in quantity gaged to the supposed demands of industry.

Such selection of engineering students as is possible through counseling and guidance programs has progressed notably in the past few years. Through its Committee on the Training and Welfare of the Young Engineer, established in 1939, The Engineering Institute of Canada has set up counseling committees in its various branches across the country. Growing out of this the Canadian Committee for Student Guidance in Science and Engineering composed of representatives from the Canadian Institute of Mining and Metallurgy and the Chemical Institute of Canada, as well as from The Engineering Institute of Canada, was set up and has expanded the original effort.

These committees have served a double purpose. They have drawn to the attention of young men who were contemplating engineering careers the requisites for success in such callings, and have diverted into other fields those who gave little promise of success in the engineering profession. At the same time, prospective students have been shown, and the news travels fast, that many senior members of the profession are interested in the personal fortunes of those who seek entrance to it. Identification of eminent practitioners with the interests of oncoming youth is an asset on both sides.

Extension of guidance service to young engineers subsequent to graduation is being planned. Formal machinery providing sponsorship of each graduate by an experienced engineer does not appeal particularly to young Canadians, but they do appreciate and welcome the informal fraternization and encouragement that comes naturally when senior engineers mix in meetings and gatherings with those who have most of their careers before them.

Although no formal steps have as yet been taken to set up a system of accrediting of the professional schools of engineering in Canada, there is little doubt that this will be undertaken in the not too distant future. A suitable mechanism would appear to be through the Committee on Applied Science and Engineering Education of the National Conference of Canadian Universities. This Committee, organized in May, 1946, had an excellent first meeting on the occasion of the Annual Conference in May, 1947. It is composed of one representative from each of the member universities and colleges of the Conference offering engineering instruction at the university level. The desirability of making an early study of accrediting in Canada will be drawn to the attention of this Committee as soon as its 1947-1948 organization is completed.

No organized measures for direct promotion of professional recognition in Canada have been devised. Individual members of the profession have, however, come into high and well-deserved prominence, not only through wartime activities, but in peaceful pursuits as well. One might cite the outstanding record of the Right Honorable C. D. Howe, Minister of Reconstruction and Supply, born an American, who, before entering political life, headed a highly successful firm of consulting engineers. General A. G. L. McNaughton, now president of the Atomic Energy Control Board of Canada and chairman of the Canadian Delegation to the United Nations Atomic Energy Commission, bears a responsibility that not only confers an honor on the profession in which he was trained, but places Canada immeasurably in his debt. Dr. C. J. Mackenzie, president of the National Research Council, has provided an illustration of the power of an able and resourceful engineer in directing the programs of a great scientific agency. The bench is honored by men who were trained as engineers and do not regret that approach. One such is the Honorable Mr. Justice R. E. Laidlaw, of the Appellate Division of the Supreme Court of Ontario. Diplomacy has made its bid, too, for the services of those with technological training. Mr. C. Fraser Elliott, an able Deputy Minister of the Department of National Revenue, has now become the Canadian Ambassador to Chile.

It may appear strange that those members of the engineering profession who most frequently come into public notice are those who have moved over into other fields as a result of the capacity that they displayed while ranked among the engineers. Doubtless this is due to the fact that in public capacities they deal much more frequently with persons than they do with things and become the more widely known for it. It might almost seem that the most effective approach to national eminence on the part of the engineer is to conduct a flank movement through territory traditionally occupied by members of other professions and callings.

RESISTANCES TO PROFESSIONAL ADVANCEMENT

Long-seated resistances to the new and broader concept of engineering as a learned profession, with all that the term connotes, still confront those who labor for its realization. One can scarcely wonder at their existence when it is remembered that in English-speaking countries up to a century and a quarter ago men prepared themselves for engineering tasks and responsibilities in the same manner as they had from the dawn of history. They learned by trial and error, by observation, practice, and apprenticeship. The English millwrights—all honor to their sturdy enterprise and resourcefulness—were but uneducated workmen with little or no thought of a higher status. James Brindley, the man who developed the great inland waterways system of Britain, could scarcely read or write and was content to receive throughout his amazing career no more than the wages of a skilled mechanic. George Stephenson and Thomas Telford began similarly, but, although achieving more exalted heights of professional prestige, they and those that followed them during many succeeding years in Britain regarded apprenticeship as the only satisfactory means by which one could become an engineer.

The things worth knowing being therefore conceived of as those that could be acquired only by operations in the shop and field, it is not strange that little thought was given to the more polite forms of learning, such as are prized by men who excel in other professions or in public life. The concept of engineering as no more than a superior trade persisted and remnants of it still remain to plague those that strive for something more.

Ignorance of what men in other walks of life think or do has bred narrow intolerance in many of those who cling to the old attitudes. Knowing little of others who live and work in spheres very different from their own, they are disposed to belittle and suspect them as the south Englanders did of the men of the north in the days before the improvement of transportation made contacts easy and frequent.

Even in these days which we euphemistically term enlightened there are many young men seeking entry to the universities that think only of the mastery of an intricate trade, the acquisition of a few scientific or technical tricks that will make

(*Continued on page 1026*)

A REPORT *to the* COUNCIL *of* E.C.P.D.

By JAMES W. PARKER

CHAIRMAN, ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT, AND PAST-PRESIDENT, A.S.M.E.

IF engineering is ever to become in actual fact, and consciously, a profession, it will be because it is such in the minds, first, of engineers themselves. Recognition of the fact by the public generally will come later, through what they see in the engineer's accomplishment and in the implications of that accomplishment for people everywhere. If engineers preponderantly devote themselves to work for the benefit of society, it will be quick to yield to their leadership. The influence of the engineer in the world will then become a potent force and, I believe, a not insufficient reward to men and women of that calling.

The E.C.P.D. has set itself the first of these tasks which is nothing less than the establishment of the profession of engineering in the minds of engineers themselves. If that is in fact the principle upon which the Council operates, then the adoption and promulgation of the Canons of Ethics for Engineers takes on meaning as does the Council's concern for the selection and recruitment of novices, for their elementary training in the schools of technology and for their subsequent maturing through the opportunites afforded them by the great scientific and engineering societies of the civilized world. It is not inconsistent with that principle that we should give attention to the wages paid to the engineer, to what we have called euphemistically his economic status and that the profession should counsel its members with regard to bargaining collectively with their employers when circumstances require it. But man does not live by bread alone and you know, as I do, that the satisfactions which impel engineers to excel in their work are in as small a degree purely selfish as in any group of people one can think of.

One of the purposes often referred to as included with the major objectives of E.C.P.D., I, for one, would like to see eliminated from our thinking, root and branch. I refer to the "enhancement of the profession." The Council may well devote itself to raising the standards both of practice and recognition, but the attempt to enhance the prestige of the engineer by any effort of self-advertisement would, in my opinion, be not only inconsistent with the high concept upon which E.C.P.D. is founded, but futile. I shall take the first proper occasion to recommend that such a change in the announced policies of E.C.P.D. be considered.

COMMENTS ON WORK OF COMMITTEES

In the following paragraphs I shall comment on certain of the work of the standing and special committees to which I wish to call attention of the Council especially, but shall not attempt to paraphrase their annual reports which are being submitted to Council in the customary manner.

During the year just ended the Council has published its Fifteen Year Report in which are described its purposes, its accomplishments during its fifteen years of existence, and its program for the future. It has been a good accomplishment marked by the contributions of talented men whose work should not be allowed to go to waste.

Perhaps, in part, as a result of the pattern on which E.C.P.D. was organized but also, most certainly, because of the enterprise and wisdom with which the members of the Committee on Engineering Schools and its successive chairmen have addressed themselves to the task, a great work has been done for the profession in the setting up of the criteria of measurement and in accrediting the curricula of engineering colleges in the United States. More recently, a similar examination and report on technical institutes has been gotten under way. In accomplishing these results, the Committee has organized field forces to make the necessary examinations of colleges and schools making application, and the work has in consequence been done effectively.

E.C.P.D. PROGRAM AT COMMUNITY LEVEL

It is of this very matter of field forces I wish to speak in reference to the work of the other standing committees of the Council. It was in 1944 that it was decided that E.C.P.D. should henceforth act directly with the local sections of its constituent societies in carrying on its program of selection and guidance and of professional training. It seems well-nigh imperative that to be effective, the work of the local sections, not only of our own but of other engineering organizations, must be consolidated and carried forward under the direct leadership of E.C.P.D. A pilot organization of the kind is already being undertaken in the belief that the E.C.P.D. program at local level must be carried on by engineers resident in the community and that only in this way can Council itself and its standing committees exert effective leadership. Already-existing organizations, local engineering councils, local engineering societies, all of them manifestations of a desire upon the part of engineers to co-ordinate and consolidate the work of the profession in their several communities, afford the organic foundation for the work. With the active approval of our constituent societies expressed through their local sections, there seems reason to believe that the interest of large numbers of engineers may be enlisted.

If the work does go forward about as described, the job of E.C.P.D. and its headquarters staff will be greatly increased. Local organizations will need headquarters-staff support in any case and especially so if, for example, it should be found desirable to invite their representatives to attend the annual meetings of E.C.P.D. That may prove a quite effective way to arouse and maintain men's interest in the undertaking. With the mere publishing of the Fifteen Year Report, inquiries reaching E.C.P.D. headquarters already indicate the need for more staff. I shall refer to this again in a later paragraph of this report.

MEASUREMENT AND GUIDANCE

This is a particularly appropriate time to give consideration to a more effective organization of effort at community level, if for no other reasons, because of the point now reached in its development by the Measurement and Guidance Project in Engineering Education in which E.C.P.D. has been associated with the Carnegie Foundation for Teaching. Approximately forty colleges are now employing the Pre-Engineering Inventory tests as administered to freshmen, and about 5500 examinations were given in the last year to college sophomores at the end of their second year, these latter being of the nature of tests of achievement rather than of aptitude.

Presented at the Fifteenth Annual Meeting of the Engineers' Council for Professional Development, Montreal, P. Q., Canada, Oct. 25, 1947.

Facilities for administering Pre-Engineering Inventory tests have been organized at 778 examination centers, so distributed, geographically that no applicant for the tests need travel more than fifty miles to take them. The student pays a nominal fee for the examination, is furnished, in turn, with one copy of the resulting grades, and has the privilege of naming one college to which the same report will be sent without further charge. Grading of all tests is done at the headquarters of the Measurement and Guidance Project where comparisons are made between the individual's test score and the corresponding norm for the entire country. It is clear that these testing procedures are rapidly coming to afford an important standard of measurement of achievement in education as well as of aptitudes for definitive courses of instruction.

Dr. Kenneth W. Vaughn, who has very effectively directed the Measurement and Guidance Project, now states that his office is ready to extend the administration of tests to high-school students in the tenth grade. While the work with students in college is of immense interest to college administrative officers, the prospect of applying this selective process to sophomores in high school appeals to E.C.P.D. with especial force as bearing directly on the recruitment of the human material needed for the continued health and growth of the profession. Community organizations engaged in student selection and guidance will find such testing procedures an effective tool for their work, the widespread employment of which can, in turn, contribute importantly to the success of the Measurement and Guidance Project.

Following a study and recommendations by a committee of educators, of which President James B. Conant of Harvard University was chairman, appointed by the Carnegie Foundation for Teaching, active discussion is now going forward among the several nonprofit testing agencies of the country regarding a single centrally organized testing operation. Your Executive Committee, believing it desirable that E.C.P.D. be in a position to be consulted in the course of a development of as much concern to it as this, accepted constituent membership in the American Council for Education, one of the sponsors of the proposed consolidation of student testing. E.C.P.D. will accordingly have three delegates to the American Council for Education. These three should be men with a broad interest in the undertaking, since they will undoubtedly have opportunity to make important contributions to the thinking of the men active in this movement.

In the meantime, Dr. Vaughn is keeping E.C.P.D. informed of developments through the Advisory Council for the Measurement and Guidance Project, which consists of Messrs. Cullimore, Doherty, Eckhardt, Lee, MacQuigg, Parker, Rogers, and Dr. Vaughn. At a meeting of this Advisory Committee in Detroit on Sept. 23, 1947, it was voted: "....that in the interests of the advancement of the profession of engineering through improved selection and guidance of students and of the continuation of the Measurement and Guidance Project in Engineering Education, sponsored since 1943 by the Engineers' Council for Professional Development, the American Society for Engineering Education, and the Carnegie Foundation for the Advancement of Teaching, that the Engineers' Council for Professional Development should immediately prepare plans for assuming more formal responsibility for the development and direction of this project in the event the present sponsorship should be altered or terminated." The resolution is being submitted to this Council during the course of the annual meeting with your chairman's recommendation that E.C.P.D. accept this responsibility as a matter of course.

EDUCATION AFTER GRADUATION

Professional training by which we mean the systematic extension of educational process after graduation from college presents what appears to be the most difficult of E.C.P.D.'s fields of interest. It would seem that the first attempt to flag the interest of engineers during this critical period of their first employment must necessarily begin months and possibly one or two years before graduation, just as the Committee on Selection and Guidance finds it essential to start the first screening of novices well before the end of secondary schooling. Recognizing this, E.C.P.D. has from time to time published inspirational and counseling material which has had good reader acceptance. During the year, Council has had in preparation another such piece of literature, a Manual for Junior Engineers, the completion of which has been unhappily postponed by the death of the author, Dr. W. E. Wickenden. His loss has been well-nigh an irreparable one for E.C.P.D. The first writing of the text of the Manual had, however, been completed. It is hoped to have one or two missing chapters supplied by other authors and the whole manuscript edited and in print within a few months.

There remains, however, the problem, how to make effective use of such publications. Without field organization to effectuate its program, the results I am sure will be disappointingly meager. On the other hand, community councils organized and acting in co-operation with college placement officers and the employment officers of local industries, should accomplish much. At this point the Engineers Joint Council has referred to E.C.P.D. its Preliminary Survey of Employer Practice Regarding Engineering Graduates, the Bailey report, so-called because Mr. E. G. Bailey was chairman of the committee which conducted the survey. Opinions on the report have been secured from the members of our Council and these have been summarized for use during this meeting. Plans for a still wider survey are on foot giving opportunity for revisions of the form of questionnaire to be sent employers. Your chairman has kept this report on the agenda of the Executive Committee in the belief that within the scope of this inquiry and report lies information which will yield light on this major E.C.P.D. interest, that is, the orientation to the rest of the profession, of the engineer just entering employment, and the bringing about of a realization on his part of the rich opportunities for individual development afforded by the discussions taking place in the meetings of the great engineering societies of the civilized world and through an informed approach to the body of technical knowledge contained in their publications.

Another report by a committee of the Engineers Joint Council will undoubtedly be referred to many times by committees of E.C.P.D. This is the quite exhaustive presentation of the results of a 1946 survey of the engineering profession, under the title "The Engineering Profession in Transition." It is the product of a subcommittee of the Engineers Joint Council's Committee on the Economic Status of the Engineer, in the preparation of which the committee staff had the active co-operation of the Bureau of Labor Statistics of the United States Department of Labor. The report has implications for the Committee on Professional Recognition as well as for that on Professional Training.

UNIFORM GRADES OF MEMBERSHIP

The Committee on Professional Recognition offers opportunity for an important service to the engineering profession in acting as the forum for discussion of uniform grades of membership in the several engineering societies. A number of societies are giving continuing attention to the possibility of establishing an acceptable pattern. The effort should not be mistaken as merely one of standardization. I believe much more is involved. In the course of E.C.P.D.'s partial listing of engi-

neering societies on national, state, and local levels, the question of determining the threshold at which societies recognize that an engineer has the attainments of a member of the engineering profession was raised. Dependence upon mere assertion by the societies themselves seems to fall short of complete acceptance of a responsibility which I am sure many members of the profession already feel. In the course of this annual meeting I am proposing to the Council that they refer to the Committee on Professional Recognition for study and report, in addition to the broad problem of uniform membership grades, the accrediting of these grades by competent committees appointed for that purpose. I am for my part convinced that recognition of an individual's attainments by his fellow engineers, using whatever measurement techniques they might decide upon, would have greater value in the eyes both of his associates, and of the public as well, than if that recognition depended solely upon licensing under governmental authority. Recognition of merit in such manner would be one of excellence rather than of the attainment of minimum standards of preparation and experience.

ADDITIONAL INCOME NEEDED

For the Executive Committee of the Council, I have to report faithful attendance at bimonthly meetings throughout the year and the successful handling of many details of administration. A review of this year's work brings me back to a matter already mentioned in this report, the need for a moderately reinforced headquarters staff. I recommend to the Council authorization for the appointment of a special committee on Ways and Means to investigate additional sources of income to meet the demands of activities which will increase as the work of the Council develops. At this writing the need would seem to be for a sustained annual income rather than for a fund as if intended for some nonrecurrent project. Such occasional requirements may well be met by special appropriations from supporting bodies, as in the past.

The finances of the Council are in satisfactory condition with the coming year's expense budget adequately balanced by income in prospect. I want to express the special thanks of E.C.P.D. for the grant from the Engineering Foundation which for next year has been generously increased to $5000 to permit continued exploratory work in the fields in which E.C.P.D. is operating.

CANONS OF ETHICS APPROVED

Finally, I would make further record of the accomplishment of the committee on Principles of Engineering Ethics on which were represented all eight supporting societies of E.C.P.D. and The American Institute of Consulting Engineers which participated in the original undertaking under the auspices of the American Engineering Council. Under the devoted leadership of Dr. Dugald C. Jackson, its chairman, this committee agreed unanimously on the text of the Canons of Ethics for Engineers which your Executive Committee then sent to all eight of the supporting societies, recommending that the Canons be approved for formal adoption by the E.C.P.D. We now have a 6 to 2 majority approval (2 not having replied by October 20, 1947) and in consequence I have submitted the Canons to the Council for adoption at this annual meeting. May I state again my earnest belief that this action on the part of E.C.P.D. is a recognizable step toward the establishment of an ideal standard of conduct for members of the engineering profession everywhere, and the symbol of a calling which all may someday recognize as in every sense of the word, a profession.

E.C.P.D. FIFTEENTH ANNIVERSARY HELD *in* MONTREAL, OCT. 24-25

THE 1947 Annual Meeting of The Engineers' Council for Professional Development, which was the Fifteenth Anniversary of that "conference body organized to enhance the professional status of the engineer through the cooperative support of those national organizations representing the professional, technical, educational, and legislative phases of the engineer's life." was held at the Mount Royal Hotel, Montreal, P. Q., Canada, on October 24 and 25, with The Engineering Institute of Canada acting as host. One of the largest delegations of representatives of the constituent societies, which are the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, The American Institute of Electrical Engineers, The Engineering Institute of Canada, The American Society for Engineering Education, the American Institute of Chemical Engineers, and the National Council of State Boards of Engineering Examiners, attended the Montreal meeting and enjoyed the gracious hospitality extended to them and their wives by the Institute.

The meeting was a memorable one. Not only was it an anniversary meeting of unusual significance and the first to be held outside the United States, but it was marked by numerous and unprecedented courtesies on the part of the host society and its members which were sincerely appreciated by the visitors and will long live in their memories. While the representatives themselves were engaged in the business which took them to Montreal, their wives were shown every consideration of hospitality that could be imagined. At the two luncheons and at the dinner on Saturday night the women joined their husbands and added greatly to the enjoyment of the meeting. Nor did the official ending of the meeting on Saturday night exhaust the attention which the Canadians showed their visitors, for all those who could stay over were entertained on Sunday by automobile trips throughout the environs of Montreal.

BUSINESS SESSIONS

All sessions of the meeting and the annual dinner were presided over by J. W. Parker, chairman E.C.P.D., past-president A.S.M.E. Friday morning was given over to a meeting of the Executive Committee of the Council and to meetings of its several committees. Sessions of the full Council, with committee members and guests in attendance, were held on the afternoon of Friday and all day Saturday. At these sessions

the business of the Council was conducted and reports of the committees were presented and discussed.

The first business of the session on Friday afternoon was a silent tribute to three members of the Council who had died during the year: T. T. Read, A.I.M.E.; W. E. Wickenden, member A.S.M.E.; and C. I. Gunness, a member of the delegatory subcommittee for Region I of the Committee on Engineering Schools.

JAMES W. PARKER RE-ELECTED CHAIRMAN

Van Tuyl Boughton reported for the Nominating Committee and the following officers and committeemen were elected:

James W. Parker, chairman (re-elected); H. S. Rogers, president, Polytechnic Institute of Brooklyn, vice-chairman; A. B. Parsons, secretary A.I.M.E., secretary; S. L. Tyler, secretary A.I.Ch.E., assistant secretary; Carl J. Eckhardt, Jr., chairman, Committee on Student Selection and Guidance (re-elected); H. T. Heald, chairman, Committee on Engineering Schools; Prof. Scott B. Lilly, chairman, Committee on Professional Training; Ole Singstad, chairman, Committee on Professional Recognition; and E. H. Robie, chairman, Committee on Information.

Appointments to the Council as representatives of the constituent societies were announced as follows: Albert Haertlein (A.S.C.E.), James R. Cudworth (A.I.M.E.), James W. Parker (A.S.M.E., reappointment), E. W. Davis (A.I.E.E.), James A. Vance and J. B. Challies (E.I.C.), H. S. Rogers (A.S.E.E.), C. G. Kirkbride (A.I.Ch.E.), and H. T. Person and S. S. Crouse (N.C.S.B.E.E.)

The following appointments to the Council's committees were announced:

Committee on Student Selection and Guidance, Zola G. Deutsch (reappointment) and H. W. Bibber.

Committee on Engineering Schools, B. F. Dodge and Huber O. Croft.

Committee on Professional Training, Edgar D. Sibley and D. B. Keyes.

Committee on Professional Recognition, R. M. Barclay and Fred J. Lewis.

REPORTS OF COMMITTEES

Reports of the Committees of E.C.P.D. and of the representatives of the constituent societies will be published in the annual report for 1947. The high lights of the work of the year were summarized by Mr. Parker in his report to the Council which was presented at the dinner on Saturday night. Mr. Parker's report is printed in full in this issue, pages 1021 to 1023.

Among significant subjects discussed and actions taken by the Council were a few deserving of special mention. Dr. Kenneth W. Vaughn, who is in charge of the Measurement and Guidance Project in Engineering Education, in which the Committee on Student Selection and Guidance has been engaged with the co-operation of the Carnegie Foundation for the Advancement of Teaching, and The American Society for Engineering Education announced that the Foundation had decided that its efforts in stimulating and directing this and similar projects had reached the point where it seemed desirable to set up a non-profit board to conduct education testing services, under which would be carried on a number of projects, including that of the E.C.P.D. Committee. It was the opinion of the Foundation, he said, that the engineering profession should control the work in this field which affected engineering education. Experience had shown that the work of the Pre-Engineering Inventory Project would be self-supporting and that its value and importance had been amply demonstrated. Extension of the work in this area to include young people from the tenth grade, on the one hand, and upperclassmen and graduates on the other afforded ample opportunity for continuing studies already under way in other age groups. It was apparent to members of E.C.P.D. present that the proposed scheme was significant and useful and that E.C.P.D. should prepare itself to participate in it.

The Committee on Professional Recognition, reported that it was making progress on proposals to the constituent societies on uniform grades of membership.

It was reported that all of the constituent bodies composing E.C.P.D. had given formal or informal approval to the adoption by E.C.P.D. of the Canons of Ethics which had been under formulation, revision, and discussion for several years. The Council accordingly adopted the Canons. The next step is formal adoption of the Canons by the constituent bodies.

On recommendation of the Committee on Engineering Schools, the Council accredited the following undergraduate engineering curricula:

College of Mines and Metallurgy, University of Texas: Mining Option, Mining Geology, and Metallurgy Option.

Michigan College of Mining and Technology: Chemical Engineering.

Northwestern University: Chemical Engineering.

On recommendation of the Committee on Engineering Schools the Council accredited the following programs of technical-institute type:

Academy of Aeronautics, Inc., New York, N. Y.: Aircraft Design and Construction and Aircraft Mechanics and Maintenance (resident full-time programs); Aircraft Design and Construction and Aircraft Mechanics and Maintenance (resident part-time evening programs).

The Aeronautical University, Inc., Chicago, Ill.: Aeronautical Engineering Drafting (resident full-time program).

Franklin Technical Institute, Boston, Mass.: Industrial Electricity (resident full-time program).

Northrop Aeronautical Institute, Hawthorne, Calif.: Aeronautical Engineering (resident full-time program).

1948 MEETING IN DETROIT

An invitation extended by Mr. Parker to hold the 1948 Annual Meeting of E.C.P.D. in Detroit, Mich., was accepted.

SOCIAL EVENTS

At the luncheon on Friday, Dean C. R. Young, Faculty of Applied Science and Engineering, University of Toronto, described the development of the engineering profession in Canada. Dean Young's address will be found in this issue, page 1019.

At the luncheon on Saturday guests of the Institute were given copies of "Canada—The Foundations of Its Future," by Stephen Leacock, through the courtesy of the House of Seagram, the publishers.

On Friday evening E.C.P.D. members and guests were entertained at a dinner at the University Club, presided over by Arthur Surveyer, past-president E.I.C.

The dinner on Saturday night, held at the Mount Royal Hotel, was enlivened by a quartette who sang French-Canadian songs. Mr. Parker presided. In recognition of the fact that he had served as chairman of E.C.P.D. during the year in which the E.I.C. joined that body, J. P. H. Perry was given a framed expression of appreciation. The presentation was made by J. B. Challies and Mr. Perry made a brief acknowledgment.

The annual report of E.C.P.D. was presented by Mr. Parker and the principal address was delivered by Allan R. Cullimore, president, Newark College of Engineering, member A.S.M.E. At the conclusion of Mr. Cullimore's address, D. C. Jackson presented resolutions of thanks and appreciation.—C.A.S.

PERSONNEL ADMINISTRATION[1]

By ALEX BAVELAS

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS.

ONE of the most damaging misconceptions of personnel administration is that it consists of the work done in the personnel office. Out of this misconception have sprung a great many books. Most of these books perform two functions, that of telling managers in industry what kind of help they may expect from the personnel office, and that of telling the people in the personnel office how to do the things expected of them. Such books are understandably concerned with selection, testing, training, rating, absenteeism, and turnover (and how to calculate the indexes thereof), house organs, recreation, safety and health, and the like. Also, they are usually well planned as reference sources for application blanks, forms, graphs, sundry record-keeping devices, and short-form methods for calculating means, medians, and correlation coefficients.

There can be no doubt of the usefulness of this kind of material for the office manager of a personnel office; and anyone with more than a casual relationship with industry will commend efforts toward better selection, better testing, better training, and better rating. However, the suspicion has been growing for some time that these devices are not the heart of personnel administration. There has been an increasing tendency in books on the subject to preface the customary material with a discussion of the "human relations" aspects of the problem. Only too often, however, such discussions have remained in the realm of theory and ideal situations with no convincing link between them and the detailed procedures recommended in the rest of the book.

EMPHASIZES PHILOSOPHY OF PROCEDURES

Pigors and Myers[2] develop a somewhat different approach. Instead of emphasizing procedures, they emphasize the importance of the philosophy which underlies the procedures. Instead of stating principles for theoretically ideal labor relations, they state a point of view and develop the principles pragmatically through repeated illustrations and case studies. Their goal is not that of presenting the personnel administrator or the manager with ready-made "tools." Rather, it is to help him gain the skills and understandings that he needs to develop for himself the tools needed in his situation.

The practical value of this approach can hardly be overstressed. Progressive personnel workers have come to realize that "packaged" materials of almost any sort—training programs, incentive systems, union-management co-operation plans—always look better in the package than they do in the plant. The longer, harder job of "tailoring" a program to fit the plant is, in the end, worth the time and effort it requires. This is so for three very important reasons. First, although every industrial organization has roughly the same general areas of personnel administration to cultivate, it by no means has the same kinds of problems to meet. The problems to be met arise because of conditions peculiar to the situation itself, and in the long run must be solved in terms of them. No "packaged" program can be designed to do the job that needs to be done. Second, the involvement and motivation of those who must administer the program are far more likely to be secured if they have participated in its formulation. And third, many of the skills and detailed understandings necessary for the successful administration of a personnel program are best acquired by living through the experience of creating and developing that program.

MANAGEMENT IS PERSONNEL ADMINISTRATION

The conception of personnel administration presented in this book rests fundamentally on the proposition that management *is* personnel administration—that personnel administration is so integral a part of the management function that it cannot be effectively delegated.

> Reduced to its essence, *good management means getting effective results with people.* Think of any enterprise that is generally regarded as successful, or of any manager who stands head and shoulders above his fellows, and ask the reason for success. The answer will usually be found in the effective work team that has been developed by managerial skill in working with people. The successful administrator gets people to work *with* him, not primarily because he has power over them and can order them about, but because he is the kind of a leader for whom they want to do their best.

If one accepts as the objective of personnel administration the welding together of individuals into "an effective work group," It is easy to see why that result can be accomplished best by the men who make up the line management of an organization. A personnel policy stands or falls ultimately in terms of the effects it created when it is applied, and nowhere are the positive or negative results so strong and long-lasting as in the relationships between a line manager and his subordinates. The face-to-face situations in which superiors and subordinates meet day after day are where the "pay-off" takes place.

Despite the logical and psychological validity of this conclusion, there is a general reluctance on the part of managers to go beyond a purely verbal agreement with its implications. The critical nature of this inescapable relationship between superiors and subordinates is, only too often, seen as a liability rather than as an opportunity. The following excerpts from "Personnel Administration" are typical illustrations:

> The president of one small firm, feeling that he ought to have a personnel specialist, decided to hire one. He was willing to give this official full responsibility in handling personnel problems, *because he wanted to be relieved of the necessity for handling them himself.* . . .
>
> A final illustration is a superintendent who urged that either a labor-relations or a personnel administrator be employed to handle problems with a newly organized union. Dealings with the union business agent were taking too much of his time and *he felt that the matter should be assigned to a specialist.* . . .

The attitudes expressed in these examples are particularly interesting from two points of view: First, the implication that the personnel problems being faced are an *addition* to the manager's job; and second, that such problems can be handled better by a "specialist." Certainly, the task of maintaining effective human relationships is not a *new* addition to any manager's job. What is new is the level of skill and understanding that the task requires. As to the delegation of these

[1] One of a series of reviews of current economic literature affecting engineering prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] "Personnel Administration," by Paul Pigors and Charles A. Myers, McGraw-Hill Book Company, Inc., 1947.

problems to a specialist, how, in all common sense, can any man hire another to have his human relationships for him? It may be that the persistent attempt to do this results from the success that industry has experienced in assigning technological problems to technical specialists. The similarity between these two situations is quite superficial, however, and what works quite well in the area of technology works not at all in the area of human relations.

FUNCTIONS OF PERSONNEL ADMINISTRATOR

But if it is the management's job to administer a personnel program, what, then, does the personnel administrator do? Pigors and Myers summarize his principal functions as follows:

1 To advise and assist the line organization in the personnel approach; in other words, to be an effective exponent of the personnel point of view in formulating and administering policies and in the problems handled by the line officials, from the top down.

2 To diagnose the stability or morale of the organization as an effective work team, by means of the various indexes of teamwork such as productive efficiency, absenteeism, accident, labor turnover, and internal mobility, and complaints and grievances; and to keep the line management informed of actual or potential difficulties that need their joint attention.

3 To provide personnel procedures and services, such as recruitment, hiring, selection, wage and salary administration, safety education, etc., as an aid to the line officers in getting more effective results through the people under them.

4 To secure co-ordination and control of these activities through top management, which has the final responsibility for seeing that they are uniformly and consistently administered.

In the opinion of the reviewer, the lasting contribution of this book will be due to the manner in which its theoretical position is elaborated through application to specific instances. In each of these areas—diagnosing organizational stability, building and maintaining work teams, wages and hours, employee services and programs—the authors have not only dealt with the specific problems involved, but have related the relevant policy considerations to their basic point of view. Also, by the use of actual case materials, they have shown in a realistic way how complex a seemingly simple situation may become when all the facts are in. All in all it is a book well designed to help the student, the individual entering personnel work, and the manager over the difficult stage of knowing the "theory" but being unsure of its practical application.

Professional Advancement in Canada

(*Continued from page 1020*)

them superior to their less practical fellows and give them an easy and secure livelihood unattended by any obligation to pull their own weight in the social, humanistic, and political efforts of their time.

SOME SUGGESTED MEASURES

While unstimulated awareness of the superior advantages of the well-educated man as contrasted with one of narrow outlook may bring eventual but slow remedy, educational institutions and professional organizations cannot allow the matter to rest there. Positive and definite action needs to be taken.

On their part the professional schools of engineering should revise upward their standards of admission, at least in so far as general educational subjects are concerned. For example, a bare pass or credit in English ought not to be accepted. A man who is so deficient in the use of his mother tongue as to be wrong as often as he is right in the use or appreciation of the spoken or written word is a sorry prospect for professional eminence. He may be a clever deviser of mechanisms and an accurate predictor of what they will do, but completely ineffective as a member of a society that depends for its progress on the co-operation of educated men dealing with situations on which their personal specialities have little bearing.

The professional associations, or licensing bodies, have likewise an opportunity for significant and constructive action. Let them scrutinize with particular care the general educational qualifications of every applicant for admission, whether he comes by way of a university or directly from the shop, office, or field. Examinations for those who are not university graduates might very appropriately include a paper in English beyond the level of the last grade in high school.

Seasoned members of the profession should lose no opportunity of preaching sound professionalism in season and out. Its leaders should be invited to pass on to students the results of their experience and observation in functioning as responsible citizens and not merely as accomplished technologists. Young men in college will accept with avidity advice of this type "from outside" while they will listen incredulously to a member of the regular staff who tells them the same thing—and perhaps rather better.

The fullest possible use should be made of biographical material in attempting to press home concepts of desirable professional attitudes and conduct. After all, every one of us is much more interested in men and what they do than in philosophical or ethical doctrines.

Plastics in Airframe Interiors

(*Continued from page 998*)

as, miscellaneous seat strips, crash pads, pinch strips, and shock mounts.

Fiberglas laminates are used as wainscot liners and backing materials for the numerous cargo-storage areas where high impact resistance is a prime requisite.

Papreg, a high-strength paper-base phenolic laminate, is also used as a wainscot backing material, supporting the vinyl-coated fabric upholstery in this area. Molded integrally with the wainscot panel is the hot-air duct, also formed of the same papreg material. The high tensile strength of the papreg allows it to be used in combination with lightweight core materials, such as various woods, in sandwich construction. Designs of this nature afford great rigidity and high bending strength combined with low weight, characteristics which are highly desirable in aircraft.

In the extreme tapered section of the fuselage, it is necessary to complicate the normal contour of the wainscot to allow for the arm rest of the seat. In this section, therefore, the new material, Es Es Hardboard, is used because of its very high impact strength and its excellent characteristics.

Thus it is apparent that each particular problem has been carefully analyzed. The designer has selected materials for the applications after a thorough study of their physical, chemical, thermal, and electrical properties. The design requirements involved in the particular problem were answered with the properties of the material selected. Sound engineering such as this has properly placed the materials in their various applications and has resulted in an airplane which will impart the luxury and service required of it in airline operation.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

COMPILED AND EDITED BY J. J. JAKLITSCH, JR.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Man Power for Research

THAT the United States faces a serious shortage of the supply of highly trained scientists and technicians was revealed in a report to the President on "Man Power for Research," by John R. Steelman, chairman, The President's Scientific Research Board.

The report states that at present we have only a limited number of such experts. This puts a ceiling on the amount of scientific effort possible today. Large expansions of our national program will become possible only as more scientists are trained.

The shortage of scientists that thus limits our scientific progress has two aspects: (1) For the next two years there will be too few scientists to permit the substantial expansion of research development programs that the nation requires; and (2) for the long run, there is danger of a shortage of high-quality scientists. There is no question that tens of thousands of students will be graduated from science courses in the next decade. There is room for serious doubt that the training they can receive under present overcrowded conditions in our colleges and universities will make them into capable scientists.

This threat to the quality of future science workers is one result of the present shortage of scientists. It takes a scientist to train a scientist, and there are not enough to perform all the research and development work that should be done immediately, as well as to train the scientists of the future in our colleges and universities.

Major effort must be directed toward improving the financial situation of schools and universities, thus enabling them to attract the scientist-teachers they must have to assure proper training of additional scientists for the future. The situation is equally acute, however, in many other fields of instruction, and there is no easy solution for the crisis in science alone.

According to the report, the shortage of scientists is a product of sharply increased demand, accompanied by a less-than-normal supply.

National expenditures for research and development increased 335 per cent during the war and are still three times as high as prewar.

During this same period, war curtailment of education, plus its aftereffects, deprived the nation of about half its normal increase in scientists—35,000, including some 5000 doctors of science.

It is not possible to estimate the number of scientists now needed in the nation, but the shortage is apparent in almost every phase of scientific effort. There is scarcely a large employer of research investigators who does not have positions which he cannot fill, or which he must fill with scientists less well-trained than is desirable. This is true in industry and government, certainly in the colleges and universities. The Atomic Energy Commission has had difficulty staffing even its reduced research programs in certain fields. A major Army program, that on guided missiles, is only three-quarters staffed.

There are of course considerable differences in the tightness of the man-power situation in different scientific and technical fields. Engineers, for example, are in somewhat more adequate supply than the other major groups, but in no case do we have an oversupply.

There are some 600,000 students now enrolled in science and engineering courses in our colleges and universities, the report states. If prewar averages apply, enough of these will, within the next 10 years, seek to enter active research to double our present total of those who are employed as scientists or research engineers in industry, government, and the institutions of higher learning. Quantitatively, this will permit a very considerable expansion of research and development programs.

However, a graduate of science is not necessarily a scientist. Numbers without quality will not make up the shortage, nor assure the nation's scientific progress.

Because of the extreme shortage of scientists there is serious doubt that the 600,000 students can be adequately trained unless broad action is promptly taken to assure that the students have what they need of facilities and scientist-teachers.

Some short-term and long-range causes of the shortage follow:

The huge accomplishments of wartime development were achieved only at the cost of stopping almost all other scientific effort. Not only were training courses interrupted, but teachers as well as students went into the armed forces or into war work. Industrial research was directed toward war.

The longer-range causes of the shortage overlap with the more immediate ones. The chief factor is the tremendous increase in demand for the work of scientists.

As a result of the war, there is a huge backlog of accumulated projects which industry now seeks to press forward as quickly as possible. Moreover, there is an expanding demand abroad for the fruits of American scientific effort and for American scientists. This need began before the war and has been increased by the destruction and disruption of European industry and institutions of learning.

The advent of the new era of scientific development, the promise of the atomic age, and the further promise inherent in the accomplishments of organized science during wartime also constitute an increasing and expanding demand for the services of scientists.

According to the report, the present shortage of scientists cannot be overcome immediately. The highly trained scientists who must spearhead all scientific effort cannot be mass-produced. Research, by its very nature, is essentially the product of a highly trained intelligence, requiring not only techniques and knowledge but the imponderables of personality—imagination, persistence, keen analysis, organizational, and creative ability. The essence of training such men is in bring-

ing apt pupils into sufficient and personal contact with able scientists.

There are not enough scientists now on the teaching staffs of our colleges and universities to make this possible and the situation will become more acute in the near future.

The extent of the shortage of teachers, in so far as quantity is concerned, can be stated briefly. Student majors in science have increased about 80 per cent since the fall of 1941, while the number of professors and instructors have increased by only 20 per cent. It is difficult to judge the quality of the instructors currently employed, but it is significant that the increase in the number of those on college and university faculties holding doctor's degrees is only 10 per cent.

The colleges and universities would require 15,000 more science instructors, including 4500 with doctor's degrees, if the prewar student-teacher ratio were to be re-established.

In conclusion the report states that as a nation, we need to do the following things:

1 Develop sources of financial support for our colleges and universities to enable them to expand and improve their facilities and equipment, to increase their instructional staff, and to raise salaries. This cannot be done for the physical and biological sciences alone, but only as a part of a general program. The specific ways of accomplishing these objectives are now under study by the President's Commission on Higher Education. But ways must be found.

2 Develop a broad program for the support of basic research in the universities and colleges. Basic research not only is of supreme importance to the whole development of science, but it is indispensable to the training of scientists.

3 Develop a national system of scholarships and fellowships to continue Federal support of students as the benefits under the Servicemen's Readjustment Act expire. Such a program should cover all fields of knowledge and not be restricted to the physical and biological sciences. This matter is also under study by the President's Commission on Higher Education.

Eight-Jet Bomber

THE U. S. Air Force's latest jet-propelled bomber, the Northrop YB-49, a flying-wing type aircraft, successfully completed its first test flight recently when it flew from Hawthorne, Calif., to Muroc Air Base, Calif., where it will undergo further testing.

The YB-49, a jet-propelled version of the Northrop B-35 Flying Wing, spans 172 ft across the wing, but is only 53 ft long, due to the absence of the conventional fuselage. Instead of the four reciprocating engines on the B-35, the YB-49 is powered by eight General Electric J-35 jet engines built by the Allison Division of General Motors. The engines, arranged in groups of four on either wing, are capable of developing 32,000 hp. Service ceiling of the plane is expected to exceed 30,000 ft.

Crew capacity of the jet-propelled bomber is 13 men, including a pilot, co-pilot, navigator, radio operator, flight engineer, bombardier, and gunner, with space for six reserve crew members for relief duty on long missions.

The landing gear of the YB-49 is of the tricycle type, consisting of two main wheels, 5 ft 6 in. in diameter, and a single nose wheel, 4 ft 8 in. in diameter.

The YB-49 is controlled by "elevons," a control surface which performs the functions of both elevators and ailerons. The plane is equipped with four vertical air separators, which extend above and below the wing surface, to increase directional stability.

Floating Turbine Laboratory

DETAILS of the operation of a temporary floating test laboratory to study casualty conditions in turbines have recently been announced with the permission of the U. S. Navy.

The laboratory was set up aboard the U.S.S. *NOA* in 1946 by the Navy's Bureau of Ships with the co-operation of the General Electric Company. Its establishment was prompted by the casualties of wartime operation which introduced new problems in this field.

Engineers spent weeks aboard the ship while tests were run, supervising measuring instruments and correlating data which enabled them to check casualties in the turbines under controlled conditions.

The engineers explained that each piece of steel in the turbine responds in expansion to any change in the temperature of the steam to which it is exposed. Thus when some casualty condition alters the normal temperature gradient in the turbine from inlet to exhaust, thermal expansion of the steel structure of the turbine may upset the carefully designed clearances allowed for rotation.

It was pointed out that casualty conditions may be imposed by derangement of some equipment external to the turbine itself. For example, vacuum may be lost when an element of the condensing system is damaged. Steam to the turbine can be secured immediately, but when it is vital to keep the ship under way by means of another shaft, the forward movement of the ship will cause the idle propeller to drive the disabled shaft at fairly high speed. This immediately sets up abnormal conditions in the turbine.

This particular problem required that a shaft be "dragged" under varying conditions of speed and partial vacuum, while keeping careful record of temperatures and pressures in the turbine.

To obtain these records, the turbine casings were opened and 44 thermocouples were placed at selected points in the cruising turbine, the high-pressure turbine, and the low-pressure turbine. Also, pressure-measuring devices were installed to measure particularly very small variations in pressure.

An interesting feature of the pressure-measuring station was a

FIG. 1 THE YB-49 FLYING WING JET-PROPELLED BOMBER

specially designed manometer board. This board was fitted with 12 glass-tube mercury columns equipped with damping tubes to lessen the effect of pitch and roll of the ship. It also incorporated a variable-level mercury reservoir and air-bleed system so that pressure differentials could be observed readily.

In this project, G. E. supplied thermocouples and instruments and produced designs for measuring devices based on experience in testing turbines in shop and service tests. Observations were made by groups organized from the ship's company. These groups worked in shifts, since some tests required as much as 18 hours of continuous operation.

The tests have provided answers to questions of limits of operations under prescribed conditions. Data have been gathered, also, to furnish the basis for calculations in projecting future marine-turbine designs.

Diamond Radiation Counter

RADIOACTIVITY studies conducted by Dr. L. F. Curtiss of the National Bureau of Standards have shown that diamonds are highly sensitive to gamma rays and may be used to detect this radiation in the same way as a Geiger-Muller counter. It has been found that a diamond placed in a strong electric field initiates sharp electrical pulses when gamma radiation is absorbed, and, as with a Geiger counter, a count of pulses gives an indication of the intensity of the radiation. The diamond counter has not yet been tested for beta radiation, but it is expected that a similar effect may be observed in this case.

To use a diamond as a counter, it is clamped between two small brass electrodes maintained at a difference in potential of about 1000 volts. When a source of gamma radiation is brought within range of the diamond, there occur across the electrodes pulses of current, which after amplification may be detected and counted on any suitable indicating device, such as an oscilloscope, a current meter, a set of earphones, or a loudspeaker. In the apparatus assembled at the Bureau, primary amplification is effected with minimum loss of original intensity through the use of a triode very close to the diamond in the circuit. The output from this tube is then applied to a two-stage amplifier, from which pulses of sufficient magnitude are obtained to operate the detecting instrument.

The pulse-producing property of the diamond is thought to be a result of its highly symmetric crystalline structure, characterized by a very regular arrangement of carbon atoms with relatively large intervening spaces. According to this theory, when a photoelectron is emitted by a diamond atom as the result of the absorption of gamma radiation, the freed electron is accelerated through the interatomic space toward the positive electrode. Within a very short distance it acquires such high velocity that other atoms along its path are ionized by collision with the release of additional electrons which in turn are accelerated in the same direction. This multiplication of charges repeats itself in rapid succession, producing a sudden avalanche of electrons equivalent to a small pulse of current. The larger the diamond the more electrons would be involved in the sudden pulse that is counted. This means that the gamma-ray sensitivity of a diamond counter should be proportional to the size of the crystal. However, adequate sensitivity is obtained with a comparatively small diamond. Apparently the diamond quickly recovers from its ionized state, as the pulses registered are extremely sharp. The diamond counter is thus a very "fast" counter, capable of indicating a much greater number of pulses per minute than is possible with the ordinary Geiger-Muller counter.

Industrial diamonds used as counters must be colorless and

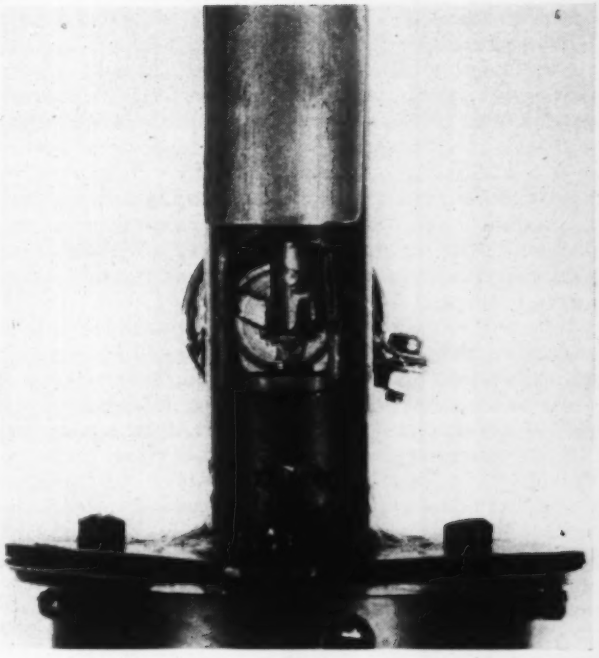


FIG. 2 ENLARGED VIEW OF DIAMOND RADIATION COUNTER

absolutely free of flaws; about one diamond in forty meets these specifications. Apparently color in a crystal, such as a diamond, indicates a change in the relation of outer electrons to atomic nuclei. Such a condition might tend to inhibit the generation of the required electrical pulse. Obviously, a flaw in the diamond would impede a surge of electrons through the affected portion of the crystal.

Diamonds tested in the Bureau's laboratories have been found to have a sensitivity per unit volume equal to or greater than that of any counter constructed by man. One of these diamonds, measuring about $^1/_8$ in. on each face, has approximately the same sensitivity for gamma radiation as a laboratory-constructed Geiger-Muller counter of the usual type. Many diamonds are larger and would thus be much more sensitive.

The conventional radiation counter lasts from three months to two years, depending upon how much it is used. A diamond counter, on the other hand, is practically indestructible, although extremely long use might produce discoloration or flaws, with a corresponding loss in sensitivity. There is no appreciable cost difference between the diamond and an ordinary counter. However, one of the important advantages of the diamond counter, in addition to sensitivity and long life, is its small size, permitting use inside the human body or in small openings in industrial equipment.

Special Lubricants

THREE synthetic oils developed for the U. S. Navy for use in ball, roller, and jewel bearings of delicate instruments are described in a report (PB-60970) on sale by the Office of Technical Services, Department of Commerce, Washington 25, D. C. Two of the oils are of the spreading type. One is nonspreading.

Development research on the three oils was carried out at the Mellon Institute for Industrial Research, Pittsburgh, Pa., between 1942 and 1946 under contract with the U. S. Navy's

Bureau of Aeronautics to discover better lubricants for aircraft instruments.

One of the oils, called N-28j, is a light lubricant for use in instruments containing small ball or roller bearings. Having a very low pour point, —90 F, the oil works at very low temperatures. It is also satisfactory at high temperatures because of its low volatility and chemical stability. It has excellent rust-inhibiting properties and does not corrode brass. It is not compatible with mineral oils or with solvents and cleaning fluids derived from petroleum products. Parts lubricated with N-28j should be cleaned with some aromatic material such as coal-tar naphtha, the report states.

The second oil, N-49w, is also designed for small ball or roller mechanisms that do not require a nonspreading lubricant. Although the oil has a very low evaporation rate, it operates satisfactorily at very low temperatures; pour point is —100 F. This oil is compounded from materials which are soluble in all common solvents and mineral oil cleaners except water and alcohols.

The third oil, N-54d, is nonspreading and is intended for use in the jewel bearings of watches, chronometers, and some types of flight instruments. Possessing unusually good lubricating properties, it gives very low coefficient-of-friction values between steel and jewel surfaces. Its most outstanding property is its viscosity at very low temperatures. Pour point is —90 F, far lower than that of any other oil with good nonspreading characteristics, the report states. Its evaporation rate is also exceedingly low and it may be mixed with practically all solvents and mineral cleaners except alcohol.

The report summarizes the research development of each of the oils, gives their chemical composition, lists their properties, and summarizes directions for preparing and blending them.

Atomic Energy

New Plutonium Reactor

EXISTENCE of a radically new type of atomic pile has been revealed by the Atomic Energy Commission, according to *Power*, October, 1947. Successful operation of the new pile, which has been running at Los Alamos since last November, marks an important step toward the solution of several key problems in generation of useful power.

In some respects the new pile is more like an atomic bomb than like previous piles, in that it uses fast neutrons and plutonium, a concentrated man-made "nuclear fuel," instead of the natural uranium used in previous more primitive piles. The new plutonium reactor is at present used to generate heat only. Thus far it has been operated at a heat output of only a few hundred watts, but the possible output is limited only by the rate at which heat can be removed and the ability of the reactor to withstand high temperature.

In this pile, as in the atomic bomb, the atom-splitting chain reaction is carried on by fast neutrons, but the means of controlling the fast-neutron chain reaction has not been revealed.

All previous piles operated on a slow-neutron chain reaction not only to permit control of the chain but also to make possible any chain reaction at all. In natural uranium the percentage of the active constituent, U235, is too small to maintain a chain reaction unless artificially stimulated.

By surrounding the slugs of natural uranium (or uranium moderately enriched with U235) with carbon or some other moderator to slow down the flying neutrons, the neutrons were made far more effective in atom splitting, thereby making a chain reaction possible.

These early piles required hundreds of tons of uranium and moderator. The new reactor, it is stated, uses no moderator. Using almost pure plutonium, it requires only a few pounds of nuclear fuel, perhaps of the order of the charge of an atomic bomb.

Presumably the new pile was installed at Los Alamos, the atom-bomb center, primarily for an investigation of pile physics. It may be years before advancing scientific and engineering knowledge makes atomic power a commercial reality.

From information so far revealed it would appear that the plutonium fuel for a small high-intensity reactor of this sort would have to come from larger natural-uranium piles. In these, some of the neutrons from splitting U235 atoms split other U235 atoms. Many of the remaining neutrons serve to convert the plentiful U238 into plutonium. This was the process used at Hanford to make plutonium for the Bikini atomic bombs.

The use of concentrated plutonium points the way to future small-sized piles suitable for certain types of mobile plants, for example, power plants for ships and manless planes. Such plants will not be used to drive automobiles because of the 50 tons of shielding required. In large ships shielding would not be difficult to carry.

British Atomic-Energy Plant

The October, 1947, issue of *Power* also reveals that Great Britain's first atomic-energy plant soon will be set up at Sellafield, Westcumberland, on the west coast of England, in a relatively isolated location in the Lake District.

The plant is intended primarily for production of fissionable material in a chain-reacting pile, but also may be used for generation of electricity. Its size is not disclosed for security reasons, but it is not likely to be as large as some premature reports have suggested. These reports have mentioned an electric-generating capacity of as much as 75,000 kw. In any event, the Central Electricity Board, which built a small generating plant at Drigg, just a few miles south of Sellafield, during the war to serve the Royal Ordnance Factories at Drigg and Sellafield, is not at present counting on any electric-generating capacity from this new atomic-energy plant; moreover, the project forms no part of the CEB's huge five-year expansion scheme.

The Sellafield plant will be erected on the site of the Royal Ordnance Factory where Courtaulds Ltd. had intended to erect an acetate-rayon spinning plant. When, several months ago, it became known that the government was strongly considering using the ROF explosives plant at Drigg for its atomic-energy project, Courtaulds felt there would not be enough labor to build and operate both plants, and agreed to withdraw its own plant from the area. Subsequently, the Sellafield location proved more suitable than Drigg for the atomic-energy plant and its use for industrial purposes was more consistent with the over-all plan for industrial relocation in the area and with proposals for a Lake District National Park, which would incorporate part of the coastline.

Construction work on the new plant is to begin shortly and, says the Ministry of Supply, "will give employment to a considerable number of men for some time to come."

The new plant will be the second link in Great Britain's atomic-energy projects. The first is production of pure uranium from pitchblende concentrates, which is going forward smoothly at the Ministry of Supply's own factory at Springfields, near Preston. One consideration in location of the plant for the second stage, production of fissionable material from the uranium, is that it be reasonably near Springfields, and another that it be an already prepared site, to save time.

A day after the announcement of the decision on the site of Sellafield, the Minister of Supply told the House of Commons that Britain's first experimental pile, at the research establishment set up last year at Harwell, Berkshire, would be in operation by the end of this year. Further, the Government hopes to establish at Harwell a university of nuclear fission, second to none in the world.

Beta-Propiolactone

A NEW organic chemical material known as beta-propiolactone which, it is claimed, promises to become as important to the chemical industry as acetylene or chlorine, was described by Dr. T. L. Gresham and Dr. J. E. Jansen, research chemists of the B. F. Goodrich Company, speaking before the 112th meeting of the American Chemical Society in New York, as "another fundamental tool in the complex science of manufacturing organic chemicals. Its use as a basic chemical makes possible for the first time in chemical history the commercial production of whole series of organic chemicals hitherto regarded as laboratory curiosities." Besides making possible the production of an infinite variety of new chemicals, beta-propiolactone promises to open up new and cheaper reaction methods of producing many basic materials already used in the chemical and plastics industries.

Substances which may be made from the new material are said to range from the liquid used in setting permanent waves to materials used in leather processing. Other fields in which it is expected to contribute either better or more economical products include: Compounds for preserving fats and oils; thermosetting resin products, which can be made tougher and less brittle; plant-growth initiators and mold-growth inhibitors; essential ingredients for certain man-made rubbers; fungicides; selective weed killers; polymerizable esters for plastic products; intermediates for the paint industry; rubber-compounding chemicals and solvents, and "polyblends," in which American rubber and plastics are blended.

Fundamentally, the method of manufacture of the substance is through the combination of ketene and formaldehyde. The basic raw materials are coal, water, and ethyl alcohol, the latter derivable from grain, petroleum, or coal. Manufacture of beta-propiolactone is now being carried out on a small scale at the experimental station of the B. F. Goodrich Chemical Company, Avon Lake, Ohio.

Electric-Motor Standards

NEW performance standards for industrial-type integral-horsepower three-phase squirrel-cage induction motors of 1 to 200 horsepower were announced by the National Electrical Manufacturers Association at a press conference held in the Hotel St. Regis, New York, N. Y., October 30, 1947.

These standards were said to be of unusual significance to the industrial motor user, in that they provide a sound basis for selecting the right motor for any industrial application, simplify the specification of minimum acceptable limits of operating performance, and assure interchangeability of motors made by different manufacturers.

According to an N.E.M.A. official, standardization in the electric-motor industry started 40 years ago and has resulted in the development of standards relating to such matters as preferred horsepower and speed classifications, mounting and frame dimensions, enclosures for various locations and atmospheric conditions, and insulation types and associated limits on ambient temperature, temperature rise, and loading.

The new performance standards which will become effective January 1, 1948, define five basic types of polyphase induction motors, designated Design A, B, C, D, and F, each of which offers a different combination of torque, speed, and current characteristics to meet the operating requirements of various industrial applications.

Most popular of these types, it was reported, are Designs B and C. Design B has a normal starting torque adequate for a wide variety of industrial machines and drives and a starting current usually acceptable on power systems. The Design C motor has higher starting ability for such applications as loaded compressors, conveyers, and the like. Design A, however, provides exceptionally high breakdown torques, but at the expense of high locked-rotor currents which normally require provision for starting with reduced voltage. Design F motors, on the other hand, have exceptionally low values for both characteristics.

Design D uses a high-resistance-type rotor to obtain variation of speed with load, desirable for some applications with rapidly fluctuating loads. This type also gives extremely high starting torques with moderate starting currents. The relatively constant speeds under varying load conditions required in most applications are provided in the other four designs, which have slip values of less than five per cent.

It was pointed out that the five motor types do not represent new departures in design, but rather the application of standard nomenclature to accepted practice in the electric-motor industry, which in turn is realistically based on the established requirements of industry.

It was also emphasized that each motor manufacturer is free to build motors to N.E.M.A. standards or not as he sees fit. Experience has indicated, however, that the advantages of standardization to the purchaser and user result in volume demand for standard items which most manufacturers are eager to supply.

Communications

RESEARCH on new developments in the use of microwave communication systems, which permit handling several voice channels simultaneously on very high-frequency radio bands, is being conducted at Yale University under a U. S. Army Signal Corps contract.

Albert G. Conrad, chairman of the department of electrical engineering at Yale, announced recently that a two-year program is under way to improve high-frequency communication techniques used in transmitting and receiving systems.

Technical name for this microwave method of sending and receiving messages is the pulse-modulated communication system. Like radar, it employs wave lengths measuring a few centimeters and it possesses an effective range equal to line-of-sight vision.

This new system has been made possible by the development of high-frequency tubes known as klystrons and magnetrons, which figured prominently in the wartime development of radar. These tubes are used in circuits in such a manner that the pulses of current that they transmit are of extremely short duration. Considerable time during each cycle is allowed for a "cooling-off" period. Thus the average power transmitted can be kept to a relatively low value while the "peak power" is quite high. By controlling the pulses as to duration, frequency, or amplitude it is possible to use these tubes for transmitting signals, human speech, or even music.

The experimental work at Yale will use radio frequencies of approximately 10,000 megacycles to transmit signals.

Some pulse-modulated systems have been developed already.

The Bell Telephone Laboratories have set up microwave relay systems which permit simultaneous transmission of several messages over long distances by means of way stations which pick up and amplify signals and shoot them along to the next relay station. Other research organizations in the United States are actively engaged in investigating problems similar to those being explored at Yale.

In addition to possible civilian uses, the microwave system has great possibilities for military communications. The antennas which are used in this new system are usually provided with parabolic reflectors in order to aim signals in a specific direction.

Handling Turbojets

SOME of the material-handling methods employed by Westinghouse Electric Corporation during production and shipping of the "Yankee" 24C turbojet aircraft engine made at the Westinghouse Aviation Gas Turbine Division, Lester, Pa., are shown in the accompanying illustrations, Figs. 3 to 5.

Fig. 3 shows a turbojet engine in the final assembly fixture, called the roll-over fixture. Final adjustments are being made to the engine accessories in preparing the engine for test. The fixture is used to hold the engine while accessories and piping are installed or removed. Since the accessories and relative piping can be in almost any position with respect to the vertical center line, it is necessary that the engine be rotated about the longitudinal axis and held in a convenient position for installation of the accessories and piping. The engine will next be moved from this fixture to the transportation and test truck.

In Fig. 4 the engine is being lowered into a transportation and test truck with a tramrail 1-ton hoist. The test truck provides a means of transporting engines to test cells and also acts as the engine support during test. This test truck rolls onto a floor-level floating platform in the test cell and is locked to the platform by two quick-acting tailstocks. The truck itself is equipped with two quick-acting tailstock-type heads at the main engine supports so that only one bolt is required to mount the engine in the truck. Thus the engine can be quickly installed in the truck, pulled to the test house by electric jitney, installed in the test cell, tested, removed from the cell, and hauled back to the assembly floor, all with only one lift of engine.

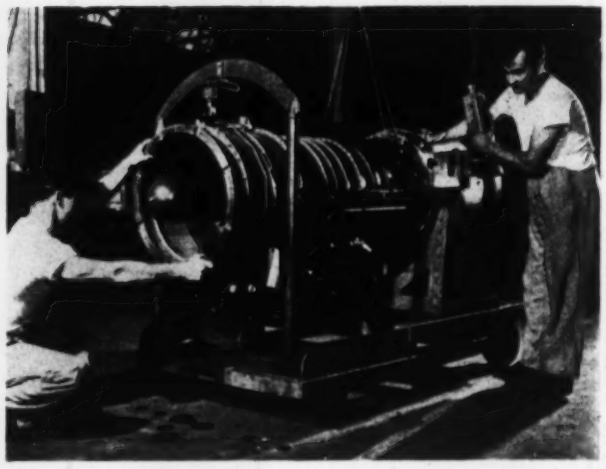


FIG. 4 TURBOJET ENGINE BEING LOWERED INTO A TRANSPORTATION AND TEST TRUCK

Fig. 5 shows the turbojet being lowered into an old-type shipping box for shipment. The box base and engine shipping supports are hidden by a barrier which is a moisture-vapor-proof material into which the engine is sealed prior to shipment, by bringing the edges of the barrier around the engine and sealing with a hot iron. Before final sealing of the barrier, excess air is drawn from inside by a vacuum cleaner and several pounds of dehydrating agent are installed to insure that the

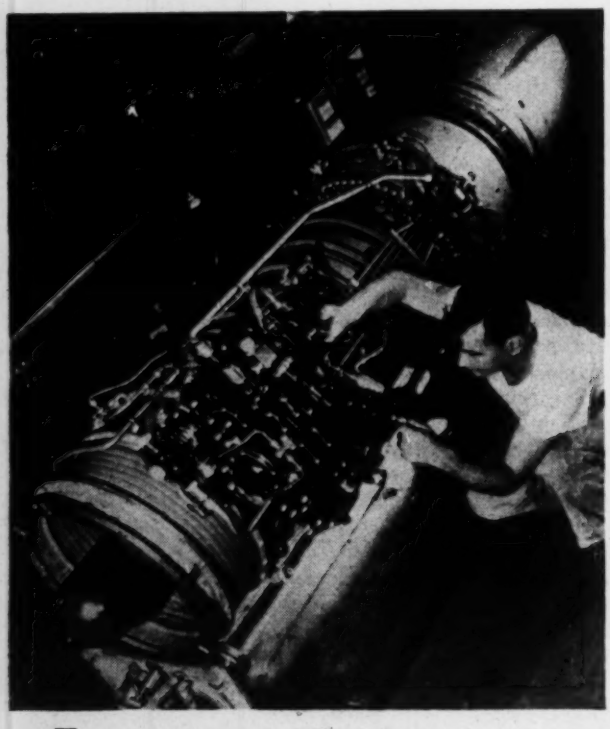


FIG. 3 TURBOJET AIRCRAFT ENGINE IN FINAL ASSEMBLY FIXTURE

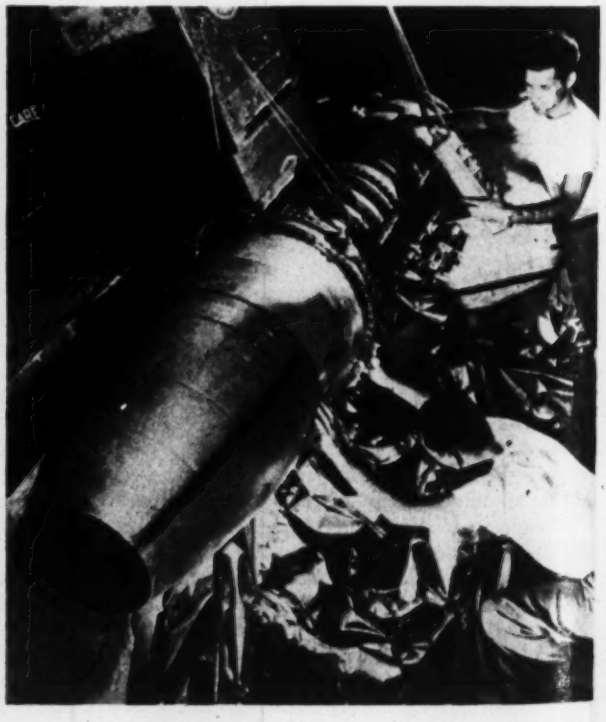


FIG. 5 TURBOJET BEING LOWERED INTO SHIPPING CONTAINER

engine is in a dry atmosphere, thus preventing any possibility of corrosion. In the newer shipping boxes the engine is supported on rubber mountings to protect the engine from shocks during shipment. The new boxes have successfully passed a 3-ft drop test when fully loaded with a complete engine weighing approximately 1200 lb.

Plastic Packaging Film

A CLEAR, tough, flexible packaging film cast from a colloidal dispersion of polyvinyl chloride plastic in water has been announced by the Reynolds Research Corporation, Gary, Ind. Called Reynolon, the new film is made from Geon latex, a product of B. F. Goodrich Chemical Company, and is the first free film made from this material.

Reynolon is said to be ideally suited for food packaging and protective coverings of many types, and is well adapted for use on most automatic packaging equipment. It can be sewed or electronically heat-sealed, and is available in gages ranging from 1 to 3 mils (0.001 to 0.003 in.) in widths of 36 to 46 in. Most important, the new material is reported to have excellent resistance to moisture-vapor transmission, good light and heat stability, with film thickness controlled to ± 0.0001 in. This latter fact is of extreme interest when buying film by the pound and in heat-sealing where uniformity is an absolute necessity

The secret underlying the production of this new film is in the method of formulating the latex and the casting which is done on a continuous stainless-steel belt of more than 300 ft in length. The belt passes through a specially designed oven where temperatures are automatically controlled to ± 2 deg. After passing through the temperature zones the belt continues back through an area where the film is cooled, stripped, and wound on a roll by automatic tension control equipment.

Processing films from latex is said to offer many advantages, such as the elimination of flammable solvents and freedom from solvent retention which is so objectionable in food wrapping. Solids content may run as high as 60 per cent.

The new film can be modified to any degree of stiffness or softness and has glasslike clarity and brilliance. Colors and pigmented films can be supplied for special cases. A wide variety of plasticizers can be used for specific problems and where edibility and contamination are important factors.

Automatic Flight

ON September 20, 1947, the All Weather Flying Center's automatic C-54D aircraft left Clinton County Army Air Field, Wilmington, Ohio, for Stephenville, Newfoundland. From take-off point at Stephenville, Newfoundland, the automatic C-54D completed a fully automatic transatlantic crossing to Brize Norton, England. Brize Norton is approximately forty miles due west of London.

On October 7, 1947, the automatic C-54 departed Lyneham, England, for the return transatlantic crossing to Stephenville, Newfoundland. On October 8, the automatic C-54 departed Stephenville, Newfoundland, and arrived at its home base, Clinton County Army Air Field, Wilmington, Ohio. Distances flown on the automatic flights totaled approximately 7780 statute miles.

The automatic airplane flew the North Atlantic route on the transatlantic crossings and maintained a predetermined barometric altitude of 9000 ft. A fuel supply of approximately 3700 gallons on each crossing was carried.

One button on the control panel, a button marked "Brize Norton, England," was pushed. This was the only manual operation during the entire flight. The automatic flight was carried out in twelve sequences by a self-contained electronics mechanism, the master sequence selector, without the aid of any human guidance such as a pilot on the ground or "mother" ship. No outside force directed the automatic C-54D. No human hand inside touched the controls.

The twelve sequences of the automatic flight are: (1) Pretake-off (manual alignment of the aircraft with the runway); (2) take-off; (3) initial climb (landing gear retracted automatically when the aircraft reaches 50 feet altitude); (4) climb to cruise altitude (flaps retracted automatically at 1000 feet altitude); (5), (6), (7), (8) navigation sequences (aircraft flies a ground course based on directional information from radio stations, magnetic lines of force of the earth, and air miles computor); (9) descent to approach altitude over a preselected radio station; (10) approach on localizer directional beam; (11) final approach and descent on localizer directional beam and glide-path beam, and (12) landing.

The entire flight, from take-off to landing was automatic. All flight data were preset on the special control-panel instruments of the electronic "brain," the master sequence selector. Preset flight data included cruising altitude, cruise heading, mileage to destination, cruising speed, rate of climb, and descent. The master sequence selector is located in the main cabin and is powered by an auxiliary gasoline generator. The navigational phase of the flight is controlled by two mileage counters and magnetic heading selectors. These instruments control the flight until the plane clicks off the preset number of miles on the predetermined heading. At the end of the first navigational sequence, the aircraft "homed" automatically to a radio station located on a ship in the mid-Atlantic. At the end of the second navigational sequence, the clicking-off of the last mile on the counter threw control to the radio compass which homed in on radio station BBC at Droitwich. Final descent was geared to the AAF Instrument Low-Approach system (localizer and glide path) at Brize Norton.

Russian Steam Turbine

A LENINGRAD works has just completed tests on a 100,000-kw 3000-rpm turbine designed for a steam pressure of 1275 psi and a temperature of 480-500 C, according to *The Engineers' Digest*, September, 1947. This is claimed to be the only single-shaft turbine in the world of this power, speed, and pressure.

As a single-unit design it offers considerable reduction in production, man-hours, and power-station space, and a 15 to 17 per cent decrease in estimated costs per kw.

A determining feature in the design has been the blading of the last low-pressure stage which is said to represent a bold step beyond previously established practice. The mean diameter is 79 in., over-all length of blade 30 in., weight 11 1/2 lb, centrifugal force at normal speed 42 tons, and maximum stress 31,700 psi.

The high-pressure side consists of a Curtis wheel which is also the regulating stage, and 11 further high-pressure stages. The low-pressure side is designed with dual flow and 5 stages. The pressure in the condensers is 0.5 psi.

Other features of the design are the free use of welding, speed-and-acceleration governing (instead of governing based on speed alone), an overspeed emergency governor, and an adjustable load-limiting device which also acts as an underspeed shutdown device. The maximum speed rise is only 4 1/2 per cent, a figure which could not have been obtained with the old type of governing even with distributing valves of infinite dimen-

sions. Shutdown in the event of overspeed or loss of oil pressure is effected by two quick-acting cutoff valves.

The regulating oil pressure has been raised to 170 psi as against the usual 110 psi. Both this and the bearing oil are provided from a gear-driven pump, and a steam-driven pump is provided for starting up.

This turbine is designed on the "subunit" principle so that various portions of it can be employed in other machines. Thus in a 50,000-kw unit 70 per cent of its details can be re-utilized, and in a 25,000-kw unit 50 per cent.

The complete unit weighs 263 tons, the high-pressure rotor 8.5 tons, and the low-pressure rotor 18.8 tons.

Reports From Germany

Parallel Compass

AN ingenious parallel compass made by the Johann Letter firm at Wilhelmsdorf, Germany, is one of several developments in German drawing instruments found in a British report (PB-79184) on the German drawing-instruments industry on sale by the Office of Technical Services, Department of Commerce, Washington, D. C.

Made of a special hard-rolled brass, this compass is constructed so that to whatever degree the compass legs are open, the lower limbs move automatically in a parallel and vertical position to each other. Thus there is no need for adjusting each limb individually. The advantage is maintained even when an extension bar is incorporated in the compass. Its maximum opening allows a circle of 20 in. in diameter to be drawn.

A unique sandpapering machine for finishing scales was investigated at the Albert Nestler firm at Lahr, Germany. The machine has eight working heads operated by a double pantograph movement. A 6 × 1-in. length of sandpaper, fed from a roll, is clamped into a fixture on the head. When the abrasive surface shows signs of wear the operator pulls the strip until an entirely new surface appears.

The investigators found similarly interesting and unique practices and equipment at practically all the firms visited. The report also discusses the manufacture of slide rules, drawing instruments of various qualities, compasses, scales, rulers, dividing and engraving machinery, planimeters, and drafting machines. A few schematic drawings are included.

Self-Centering Edging Machine

Two German self-centering lens-edging machines and test results of their operational efficiency as determined by the Ross optical firm in London are described in a British report (PB-79190) on sale by the Office of Technical Services.

The principle underlying the self-centering edging machine has been known for many years, the report states, but has never been widely used in the optical industry. Following an investigation of the German optical firm, Voigtlander and Son, at Brunswick, Germany, British experts evacuated two machines, a Bothner self-centering edging machine and another made by Voigtlander. In London, a thorough comparative study of the design, construction, operation, and performance of both machines was made.

The Bothner machine, found superior to the Voigtlander, consists of a welded tubular and sheet-steel stand carrying a substantial cast-iron platform. The platform carries the head of the machine and most of the mechanism. The lens to be edged is held between two chucks. Once set, the lens is edged by a diamond wheel carried on a casting attached to the head of the machine. After the machine is properly set up, the lens centralized, and the grinding and workheads started, the machine proceeds automatically through the cycle and stops the workhead to permit the finished lens to be removed.

The Voigtlander machine works on the same principles as the Bothner machine but has several disadvantages. Among others, its controls are not easily accessible, a guard is required over the wheel and work, only one speed is available, and twice the floor space is needed.

Tantalum

The production of tantalum by the Siemens and Halske firm in Germany is described in a report (PB-20567) on sale by the Office of Technical Services. This German firm and one American firm were the only firms making tantalum in the world during the war, the report states.

Siemens and Halske had two plants, one at Vienna and one at Siemensstadt, which turned out rod, sheet, wire, tube, and other tantalum products at the rate of two tons a year, according to the report. Thirty per cent of the output was used for making Siemens radio valves and the rest was turned over to other customers, particularly to the chemical industry.

The raw materials used were tantalite ore obtained in West Australia and parts of Africa, crude tantalic acid from Belgium, and crude potassium tantalum fluoride produced by a German firm.

The processing of the ore and the working of tantalum powder into rod, wire, sheet, and tube are described in considerable detail. The Siemens products were of very high grade and, as in the United States, found wide application as a radio-tube material, and particularly for anodes, cathodes, and grids working at high temperatures and under critical conditions

Sewage Disposal

Methods undertaken in the Niers River district in Germany to cope with the disposal of city sewage heavily polluted by industrial effluents are described in a report (PB-78208) on sale by the Office of Technical Services.

The Niers River, a small tributary of the lower Rhine, has a rate of flow of about 250 gal per sec. It receives waste of textile mills, bleacheries, dye works, tanneries, and paper and straw mills. The concentration and composition of these effluents (7,500,000 gal daily) makes for a pollution load equivalent to the quantity of domestic sewage of 600,000 people. To this daily load is added 5,000,000 gal of the normal domestic sewage of 200,000 inhabitants. Thus the 12,500,000 gal of sewage to be treated daily corresponds in degree to pollution to a total of 20,000,000 gal of domestic sewage while the rate of flow of the Niers River amounts to only 21,600,000 gal per day—a ratio of almost 1:1.

Early laboratory tests using conventional methods of precipitation with ferric chloride, settling, and subsequent aeration with activated sludge resulted in a satisfactory effluent. However, the chemical sludge was very difficult to digest and the costs estimated on a mass basis prohibitive. The Niers process was developed by a German chemist, Dr. H. Jung, to overcome these two drawbacks.

The technical difficulty of digesting the sludge properly was solved by depriving the sludge of part of its iron content and mixing it, prior to digestion with the other sludges produced in the plant.

The economic difficulty was solved by using cheap iron scrap (cast-iron turnings) as the sole initial source of iron, instead of iron compounds, and by recovering about 60 per

cent of the iron from the sludge and returning it to the process after being used as a coagulant. Ferric hydroxide in the sludge is reduced to ferrous hydroxide by aeration and the latter is dissolved by carbon dioxide to form soluble ferrous bicarbonate. Stack gases containing 10 to 12 per cent carbon dioxide are mixed with the incoming sewage under slight pressure prior to treatment with the fine iron particles.

Rayon Weaving and Throwing

A comprehensive report (PB-81055) on manufacturing methods and mechanical equipment used in weaving and throwing continuous filament types of rayon yarn in Germany is now available from the Office of Technical Services. An over-all picture of the rayon weaving and throwing industry in Germany is included in the report. Details and illustrations of manufacturing methods, and mechanical equipment found to be different or novel from the American viewpoint are stressed.

Some of the processes and machines are unknown to the United States textile industry, the report states. The outstanding discoveries described in the report include a double-twist spindle for uptwisters; a hollow spindle used to convert a two-deck uptwister into a combination twister-doubler; a three-deck uptwister used for silk and rayon crepe yarns; a loom without superstructure; and a plastic heddle to replace steel heddles. An apparatus used on looms to facilitate abnormally high pickage in special fabrics; and machines of revolutionary design which produce cuprammonium yarn by a continuous spinning method are other noteworthy German developments described in the report.

In the field of throwing equipment it was found that the German machines were well-built, generally with heavier frames than American makes, and considerable attention was given to fine precision machining and elimination of vibration.

Thermoperm

Information on the composition, manufacture, and thermal and magnetic properties of "Thermoperm," a complex type of nickel steel used in Germany as a temperature-compensating device in the construction of magnetic tachometers, is contained in a British report (PB-79574) on sale by the Office of Technical Services.

The report describes the tachometer as consisting of a strong permanent magnet located on a spindle connected to a flexible cable drive which in turn is attached to the geared unit fixed to the shaft whose speed is to be measured. The magnetic field is nearly constant. Between the magnetic poles a soft iron return-contact ring rotates with the magnet. In the annular space between the rings and the magnetic poles is a light aluminum-alloy indicator cup or drag link acted upon by the strong magnetic field. The cup rotates on frictionless bearings in response to eddy currents produced as the magnet and return-contact ring rotate. This rotating force is opposed or counterbalanced by spiral springs. The angle of deflection of the indicator cup and pointer from the zero position is proportional to the speed of rotation of the magnet and the shaft to which it is attached. Thus the instrument can be calibrated to read in miles per hour.

Since the resistance of the aluminum-alloy cup or drag link varies with temperature, compensation for temperature is obtained by fixing shunts of Thermoperm to the poles of the magnet. With a rise in temperature the conductive capacity of the shunts will decrease so that fewer magnetic lines of force pass through them, the greater number being diverted to and strengthening the magnetic field. The opposite is true with a fall in temperature.

The composition of the most common type of Thermoperm, details of its manufacture, descriptions, and photographs of German magnetic tachometers, and pertinent tables are included in the report.

Gas-Turbine Materials

GREAT strides have been made in the development of suitable materials for gas-turbine service within a comparatively limited time, E. M. Phillips, member A.S.M.E., of the General Electric Company's Aircraft Gas Turbine Division at Lynn, Mass., told delegates attending a recent S.A.E. National Aeronautics meeting in Los Angeles, Calif.

Mr. Phillips pointed out that development of materials capable of operating at high temperatures was necessary for the successful development of the gas turbine.

Selection of promising materials has been based on creep and rupture test results, he added, declaring that development of materials in use requires knowledge of all properties of each material and extensive laboratory testing, including behavior under vibration or stress or temperature variation, heat shock, notch sensitivity, corrosion and erosion by hot gases, ductility and stability.

One difficulty which required a vast amount of testing to destruction, was obtaining satisfactory large forgings of austenitic materials. This problem was best solved by the development of the so-called "composite" wheel. This consists of a central or hub-and-disk portion of ferritic low-temperature steel and an outer or rim portion of high-temperature austenitic material solidly bonded together by a suitably controlled weld, using austenitic weld rod. This design has an additional advantage in that the hub forging can include the shaft extension, thus eliminating the necessity of welding on a shaft extension.

He said also that despite the fact that much progress already has been made, extensive additional data are needed to develop new materials and to understand the laws governing high-temperature material performance. A great deal must be done also to develop controls needed to insure that materials always will possess the most desirable properties.

Mobile Unit Substation

COMPLETELY factory-assembled and wired, a General Electric 2000-kva 60-cycle mobile unit substation mounted on a three-axle full trailer will be solving maintenance, emergency, and repair problems throughout the system of the Jersey Central Power and Light Company.

The transformer on the substation is a three-phase fan-cooled unit rated 13,200/33,000 volts to 23,000/4000 grounded—Y/4600. Proceeding from the high side, the apparatus consists of air-break disconnects, high-voltage lightning arresters, fuses, transformer, low-voltage arresters, and a control cabinet containing a meter panel and an oil-filled breaker to protect the low-voltage circuit.

As a stand-by unit, the mobile substation is used to by-pass permanent substations so that repair and maintenance work can be accomplished with the permanent substation de-energized. In the event of system failure, the mobile substation is rushed to key locations to restore service.

The equipment is encased in permanently mounted metal side plates. All high-voltage parts less than seven feet from the ground level, as well as the transformer cooling fans, are protected against accidental contact. All exposed low-voltage auxiliary wiring is enclosed in armored cable.

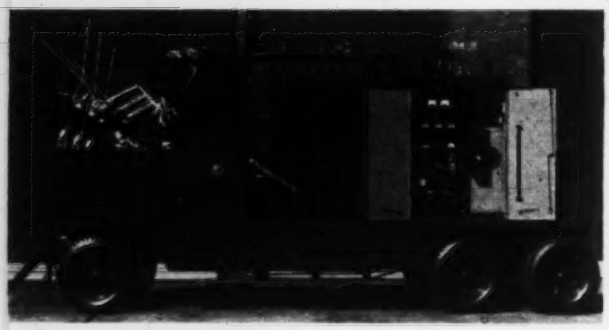


FIG. 6 MOBILE UNIT SUBSTATION

Ground terminals with cable clamps are provided at three separate points on the substation to facilitate adequate grounding and provide safety to operators.

The breakers included in the unit have ample interrupting capacity for the transformer kva with which they form a unit. The switchgear compartment encloses a swinging panel upon which are mounted relays, meters, and controls. Atop the switchgear compartment are lightning arresters which protect the low- and high-voltage sides of the transformer.

The unit meets with I.C.C. and State of New Jersey Motor Vehicle Laws.

The equipment is designed so that it can be energized and operated when out-of-level at a maximum of five degrees in any direction. The substation, which will be towed to its destination, is suitable for a maximum speed of 40 mph in transit on first-class paved highways.

Gas-Turbine Laboratory

THE new gas-turbine laboratory of the Massachusetts Institute of Technology, equipped with the most advanced facilities for graduate instruction and fundamental research in this field of engineering, was dedicated October 7 at ceremonies attended by high Army and Navy officers, members of the Institute's corporation, educators, and a notable group of industrial leaders representing almost every field of engineering.

The new building is two stories high and is of heavy reinforced-concrete construction with a facing of buff-colored brick to harmonize with the surrounding buildings. Construction of the laboratory was made possible by grants totaling more than $500,000 from a group of leading industries interested in fundamental research on gas turbines. The contributors were Mr. Alfred P. Sloan, Jr., the General Electric Company, the Westinghouse Electric Corporation, the United Aircraft Corporation, the General Machinery Corporation, and the Curtiss-Wright Corporation. The United States Navy contributed notably to the construction of the laboratory by providing some of the equipment.

In expressing his appreciation for this important new research facility at the Institute, Dr. Karl T. Compton, member A.S.M.E., president of the Institute, said that recent advances in gas-turbine research indicate significant possibilities for the future and emphasized the need for specialized technical studies of the new techniques required in the construction of machines operated at extremely high speed and high temperature. It is such a program of research that will be undertaken in the new gas-turbine laboratory, emphasizing the educational importance of such research in the training of young engineers.

The equipment of the new laboratory includes a supersonic wind tunnel and unique facilities for research on the elements of compressors, combustion devices, jets, and gas turbines.

One of the most interesting pieces of apparatus is the high-speed wind tunnel capable of operating up to three times the velocity of sound. This tunnel will be used at first to study the problem of the flow of air into the inlet of propulsion engines for supersonic airplanes.

Another piece of apparatus will make it possible to investigate the nature of flow through compressor and turbine blades. This instrument, known as a cascade device, will operate at first at low velocities and with this background of knowledge, a device for operating at high speeds will be designed. A large air compressor has been installed to supply air to combustion apparatus which will burn up to 6 lb of air per sec at a pressure of 50 psi.

An instrument known as an interferometer makes it possible to measure the density in a moving fluid by passing a beam of light through it. This device has been constructed to be used in connection with studies in the high-speed wind tunnel and cascade apparatus.

British Gas Turbines

A RECENT news letter from The Society of British Aircraft Constructors, Ltd., states that the events of the past months, culminating in the S.B.A.C.'s Display and Exhibition at Radlett Aerodrome, provide undoubted evidence that Great Britain will be the first country to build and put into service airliners fitted with propeller-driving gas-turbine engines.

Trials which began in September, 1945, and now about to reach an intensive stage, have established the superior merits of the turboprop over the conventional piston engine for many classes of air transports, and there is little reason to doubt that the country which takes the lead in this new branch of aero engineering will gain advantages which, properly exploited, might put it ahead of all rivals.

The gas turbine adapted to drive a propeller is halfway between the piston propeller engine and the simple gas-turbine jet engine. Flight conditions are such that only aircraft designed to fly at 500 mph or more can reap the full benefit of jet propulsion. No such airplanes intended for civil use exist at present, although some are projected, and at least one, the D.H. 106 transatlantic airliner, is under construction.

Several of the newer types of contemporary airliners can, however, gain substantial benefit by the substitution of their piston engines by turboprops. Some of the British airliners scheduled for change-over to gas turbines are the Airspeed Ambassador, the de Havilland Dove, Handley Page Hermes, and the Miles Marathon. The first of the Bristol Brabazons (Type 167) eight-engined, 127-ton transatlantic airliners will have piston engines; the second and third, gas turbines. Some of the newer British airliners will make their debut with gas turbines; among them are the Armstrong Whitworth Apollo, the Saunders-Roe SR/45 six-engined transatlantic flying-boat, and the Vickers-Armstrong Viscount.

None of these types is likely to be on the airways before 1949 or 1950, but the prototypes of some are expected to begin their tests next year. One of the largest will be the Hermes V, two of which are now being built at Cricklewood, in northwest London. Another, rather smaller, will be the Marathon.

First gas-turbine propeller engine to pass the Air Ministry's stiff Type Approval tests was the Bristol Theseus. Two of these engines replaced two piston engines on a four-engined Avro Lincoln.

A demonstration offered proof that the two Theseus engines unaided, were powerful enough not only to keep the bomber air-borne and under full control but to allow the pilot to show off its maneuverability by executing steep turns and climbs. Lack-

ing a direct comparison, spectators could hardly say whether the Lincoln flying on its gas turbines was any slower or less maneuverable than the standard Lincoln using all four of its standard piston engines.

Meanwhile, tests continue with gas-turbine jet engines for the purpose of discovering their operational value in commercial aviation. Trials with an Avro Lancastrian fitted with two Rolls-Royce piston engines and two Rolls-Royce Nene jets, which began more than a year ago, have been continued by another Lancastrian fitted with two de Havilland Ghost gas-turbine jets. Ghosts will power the six-engined D.H.106 transatlantic airliner mentioned earlier.

From the results so far achieved, concludes the news letter, Great Britain has reason to be optimistic about her chances of putting the gas-turbine propeller engine into air-transport services before anyone else. She was the first to make a success of the jet engine and if she can continue to devote the time, energy, and money to the development of the mechanically more complex adaptation which promises to bring a new standard of operating efficiency to the airways, she will outstrip all her competitors and become the world's leading civil air power.

Railroad Stabilizer

A SHOCK absorber which, it is claimed, will eliminate many bumps in railroad tracks or highways, has been developed by Westinghouse research engineers to provide train and bus travelers with smoother rides. The new stabilizer is designed to eliminate more than 60 per cent of the bumps and sway caused by irregularities in tracks or roads, enable trains to take curves at more than 25 per cent greater speeds, bring about a 4 to 1 over-all improvement in riding ease of trains and buses, and permit increased traffic over present rails and highways.

The stabilizer is now being road-tested by one of the nation's leading railroads and application tests are also being planned by a large bus manufacturer.

It is stated that the stabilizer automatically moves the car trucks or bus wheels up and down to compensate for bumps in the road surface. Train wheels are moved from side to side to correct for track weaving. A tilter banks the car or bus body as it rounds a curve. As applied on a railroad car, this is done by six hydraulic cylinders and a pair of motor-driven screw jacks. Four cylinders take care of vertical bumps and two for sideway.

When the car comes to a bump or dip in the track the floating weight instantly senses the motion of the body as it begins.

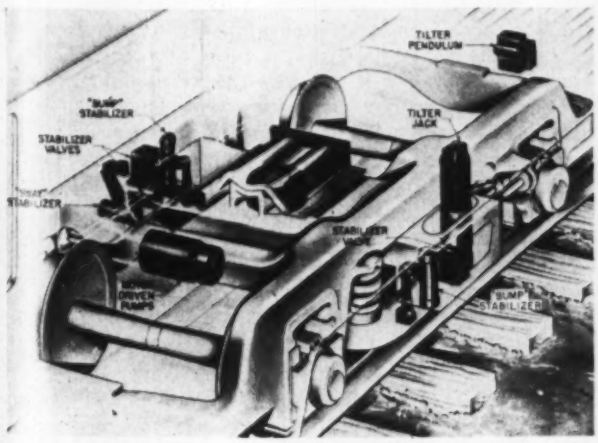


FIG. 7 PHANTOM DRAWING SHOWING STABILIZER INSTALLED ON A RAILROAD CAR

The movement opens one valve and closes another, causing oil under high pressure to flow into the proper cylinder. The piston in the cylinder moves with just enough force in the right direction to counteract the bump and hold the car body virtually motionless. This is said to take place in 0.003 sec. The same type of action moves the wheels right or left to correct for sideway and the car body moves forward in a straight line. Flow of oil for the hydraulic system is maintained by motor-driven pumps.

When the train enters a curve, the gyrocontrolled pendulum regulates two electrically-driven screw jacks placed at diagonal ends of the car body. If the speed is not quite right for the bank of the track, centrifugal force swings the pendulum. This closes an electrical contact to operate the two jacks which immediately tilt the car body to the correct bank angle.

It is reported that the tilt mechanism can add up to six degrees of additional bank in either direction within two seconds. So precise is its sense of balance that even when going around a curve at theoretical 40 per cent overspeed, the tilter can bank the car to within one degree of perfect equilibrium. The permissible speed on curves depends on the design of the locomotive, but even with this limitation the tilter will make possible 25 per cent overspeed without passenger discomfort.

Going around a curve even at high speed, the passenger will be able to stroll down the aisles without difficulty. And when the train comes to a standstill on banked curves, the car body will be held perfectly level.

Although the best shock absorbers have been able to limit resonance to about three inches, the new stabilizer is said to cut it to less than one inch, an improvement of some 300 per cent. Also, by applying all the hydraulic power of the stabilizer to the wheels and helping them move up and down, the traction power of the car is greatly improved.

Passenger comfort is the chief aim of the stabilizer, but improved train schedules should also result from its use since much higher speeds will be possible with comfort.

The same equipment used on railroad cars, modified slightly, can be applied to large passenger buses. In the case of buses, however, the system will be simpler due in part to the omission of lateral sway stabilizers, since buses have no swing-link suspension.

Rocket-Motor Pyrometer

ROCKET exhaust flames believed to reach temperatures of as much as 4000 F can be measured by a new device described at the annual meeting, Cincinnati, Ohio, October 25, of the Optical Society of America, by Donald H. Jacobs, supervisor, Long Range Navigation Section, Aerophysics Laboratory, North American Aviation, Inc. The measurement is achieved by passing a beam of light through the flame to a photoelectric cell.

A light source in the instrument sends a beam of light through the exhaust flame of the rocket and another beam of light from the same source is by-passed around the flame by a series of mirrors. A system of mechanical shutters causes these two beams of light to fall alternately upon a photoelectric cell. The photoelectric cell is connected to various monitoring, amplifying, and recording circuits. Studies of the theory of this device show that if the brightness of the light source is varied so that the photoelectric cell always receives the same amount of light from the beam that passes through the flame and the beam that passes around it, the temperature of the rocket exhaust will bear a known relation to the temperature of the light source.

With this instrument it is possible to record automatically

and continuously the fluctuations in the temperature of a rocket motor as the motor starts up and runs under various experimental conditions. Provision is included in the instrument for means of making a survey of the change in temperature across various cross sections of the exhaust. It is not necessary that an instrument operator be in the vicinity of the rocket motor when it is running. Hence the instrument removes the problem of danger to operating personnel.

It was pointed out that this new instrument makes possible much research on rockets and rocket fuels that could not be performed previously.

Atomic-Bomb Effects

THE National Research Council has been requested by a Presidential Directive, issued at the request of the Secretary of the Navy, to initiate a long-range study of the genetic effects of the atomic bombs dropped on Hiroshima and Nagasaki, according to *Science*, October 10, 1947. In January, 1947, the Council established a Committee on Atomic Casualties.

A report of preliminary genetic studies based on observations made by Lieut. James V. Neel, M.C., A.U.S., in Japan, and presented at the meeting of the Conference on Genetics covered by the Committee on Atomic Casualties on June 24, 1947, points out that inasmuch as the majority of mutations occurring in animals are recessive, only the relatively small proportion of mutations which are dominants may be expected to show effects in the first postbomb generation. The potential range in their effects is very wide. Dominant mutations with large clear-cut manifestations can be expected to be much rarer than those with smaller but possibly quite significant effects on bodily dimensions, life span, etc. But the detection of these latter is a matter of great difficulty with present techniques. For practical considerations investigation will have to be concentrated chiefly on the class with such large effects as may lead to stillbirths, to live births with gross external abnormality, or to internal defects causing death or serious illness in infancy.

Since there is no general agreement as to what proportion of cases of abnormal fetal development is genetically determined, and what proportion is due to nongenetic factors, an increased incidence of morphologically abnormal fetuses following irradiation may not be used as an index of the frequency of genetic change until the nongenetic effects of this irradiation on the reproductive history of the mother have been determined. This point will be very difficult to evaluate.

It is obvious that in this case the approach to the problem of genetic effects is the statistical one. It is unlikely that any individual and specific pathology in a postirradiation generation can ever be attributed with certainty to the effects of the bomb, but if there is a definite increase in the occurrence of abortions, miscarriages, stillbirths, and abnormal products of conception, one may surmise that this is related to the bombing—although some of the effects need not necessarily be genetic. Appropriate control studies in other Japanese cities are therefore of the utmost importance.

The Japanese had recognized the importance of genetic studies and, under great difficulties, were organizing a program in Hiroshima when the Atomic Bomb Casualty Commission arrived. They had planned to compare the present and future frequency of abnormal births in Hiroshima with the frequencies reported in their medical literature and vital statistics during the prewar years. But it is by no means sure either that the prewar figures were sufficiently accurate or that the present reporting of vital statistics would be wholly effective in detecting rare effects of the atomic-bomb radiations. It cannot be too strongly emphasized that there is at present absolutely no reliable evidence on which to base any opinion concerning the absolute or relative frequency of congenital abnormalities among children being born in Hiroshima and Nagasaki. Unfortunately, a good deal of misinformation is currently in circulation.

In view of the fact that the Japanese are actively attempting to initiate genetic studies, it seems that any American efforts which may materialize should contemplate co-operation with the Japanese in an attempt to insure an efficient and satisfactory program. The Neel report contains the following specific recommendations as to the organization of a program:

1 Organize in Hiroshima, Nagasaki, and a control area or areas, a modified system of pregnancy registration, this to include the irradiation history of the parents.

2 Obtain as complete information as possible on the outcome of each registered pregnancy.

3 Follow up each report of an abnormal termination of pregnancy or a congenital malformation with detailed family studies.

4 Develop a system of checking on the completeness and accuracy of registration of births and deaths, such as requiring at intervals dual registration by both the family and the obstetrician or midwife.

5 Conduct these studies on a sufficiently large scale so that the results will have statistical significance.

6 Integrate this program with a system of periodic examination of the offspring of irradiated persons, and with careful death certification, so that genetic effects not apparent at birth but detected subsequently may be recorded. In particular, causes of infant mortality should be accurately recorded.

7 Place this program in competent Japanese hands, through the Japanese Government, with only enough American supervision and co-operation, including supplies, to facilitate a successful program.

This program must extend over a period of 10 to 20 years before a significant amount of data can be accumulated, and quite possibly an even longer period of study, extending to the second and subsequent generations, will be indicated.

Boiler Control

A METHOD of controlling combustion in hog-fuel-fired boilers by the brilliancy of the flame, furnace wall, or fuel bed, has been developed by the Bailey Meter Company, Cleveland, Ohio.

Because hog fuel comes in many different forms it differs in size, Btu content, moisture content, volatility, ignition temperature, and burnability, and at times may be difficult to control. However, it is said that this new system has been doing a satisfactory job of controlling its combustion.

The new system utilizes a standard arrangement in that forced draft is controlled from steam pressure, induced draft is controlled from furnace draft, and fuel feed is controlled from steam flow; but differs in that the fuel feed is readjusted by brilliancy instead of by steam flow-airflow ratio. Brilliancy is measured by a photovoltaic cell connected to a Bailey Pyrotron pyrometer.

In this new type of control a steam flowmeter measuring boiler output proportions fuel feed to steam flow. It does this by setting up an air loading pressure which actuates the fuel-feed control drive. The air loading pressure from the steam flowmeter is combined with the air loading pressure set up by the brilliancy meter in an air relay to form an average air loading pressure. This is transmitted to the fuel-feed control drive.

If the flame brightens it is a sign of an excess of combustion

air and the fuel feed is increased gradually until the flame darkens to the required brilliancy. If the flame tends to darken it is a sign of a deficiency of combustion air and the fuel feed is correspondingly decreased. A darkening of the flame also occurs when a wet fuel is fed on top of a dry fuel; the fuel feed then slows until burning resumes.

This type of control has been installed on a hog-fuel-fired boiler at a large Pacific Northwest lumber mill and has proved to be very successful in this type of firing.

Traffic Congestion

TRAFFIC congestion is a disease, and solutions short of off-street parking are "palliatives and not a cure," Roy W. Crum, Washington, D. C., director of the National Research Council's Highway Research Board, declared at the recent fall meeting of the American Society of Civil Engineers, Jacksonville, Fla.

He stated that traffic congestion can be cured only through public realization and that the malady is menacing the cores of American cities and threatening our whole urban organism with irreparable economic losses. The engineering approach required is to collect, appraise, and study all pertinent facts as a basis for prescribing remedies. The over-all objectives of course are to expedite movement, satisfy parking demand, increase safety, by-pass movement of cars not wanting to stop in the congested area, provide wider travel lanes by clear space along curbs, channelize traffic and eliminate the repressive effects of cruising which is indulged in while motorists seek parking space.

Discussing methods utilized by engineers in traffic studies to determine the parking demand in congested areas through origin and destination surveys of vehicles, he pointed out that in addition to household and cordon interviews with motorists, a survey of existing parking conditions is necessary. He laid special emphasis on the fact that it is necessary to make an appraisal of the space-hours of curb parking to be eliminated in order to obtain desirable operating conditions and obviate violations.

Mr. Crum cited the following examples of surveys made in various parts of the country:

In Atlanta, Ga., and Detroit, Mich., 3000 and 5000 Boy Scouts, respectively, assisted in interviewing parkers to obtain data regarding arrival time, departure time, license number, home address, destination, and purpose of trip. In Providence, R. I., a parking survey costing $3900 was conducted for 12 days by 45 men who inventoried parking spaces, made a cordon count, conducted parking interviews, and ascertained from a previous city-wide origin and destination survey the space-hour demand and deficiency.

The results on traffic flow of the many remedies that have been tried in various cities are not yet available in detail. Adequate traffic and parking solutions are expensive, and needs should be established definitely and remedies based on complete surveys, with consideration given to existing local and state laws and legislation that may be needed in relation to parking.

He also cited indications that businessmen and the general public are beginning to recognize the bad effects of traffic congestion on business conditions.

With many engineers participating, the Chamber of Commerce of the United States recently conducted a businessmen's conference on urban problems in Washington, D. C., at which the problem was discussed from the viewpoint that the business element of each community can perform a valuable service by participating in the consideration of various proposals, by helping to mobilize public opinion behind accepted solutions, and by helping to translate plans into definite accomplishments. One half of the time the conference was given to traffic and parking.

Mr. Crum then discussed the prohibition of parking on practically all of the streets in the central business district of Philadelphia, Pa., beginning with January, 1946, after a survey of postwar swollen traffic indicated that:

Only slightly more than 3 per cent of the persons entering the district during shopping hours came in cars that were parked at the curb, legally or illegally.

Only 21.5 per cent of the parked-cars' occupants came to shop.

Of the 69.3 per cent of the parked motorists who said they came on business, 18.3 per cent were salesmen who came to sell, and not to buy, and store owners themselves constituted another 12.5 per cent of this group.

More than 78 per cent of the cars parked for less than one hour, yet the 3 per cent that parked more than five hours took up 18 per cent of available curb space.

Interviews with shoppers revealed that 75.4 per cent came to the area by public transit, 13 per cent by train, 8.4 per cent by private automobile, and 3.2 per cent walked.

Of the shoppers using private cars, 26 per cent parked in the street. Thus about 3 per cent of the shoppers parked their cars at the curb.

Radioactive Hazards

GREATLY advanced developments in science during the war brought about the discovery of new elements, and the newly acquired radioactive substances have greatly increased the need for alert industrial medicine and hygiene, Dr. R. Emmet Kelly, of St. Louis, Mo., medical director of Monsanto Chemical Company, said recently in an address at the annual meeting of the American Public Health Association, Atlantic City, N. J. Dr. Kelly said that health problems associated with the nation's newer technology have emphasized the need for more immediate physiological and biological investigations.

He stressed that radioactive materials can be manufactured, shipped, and handled safely and that to date the record has been excellent. He warned, however, that as the use of the substances becomes more widespread, greater danger may exist through complacency and lack of appreciation of their hazards.

The deleterious effect of radioactive materials on humans is produced by setting up destructive ionizing reactions in the tissue. The response varies with the type and amount of exposure. Damage to the germinal cells, the bone marrow, and the lymphatic tissues, and the occurrence of malignant changes comprise the conditions to be expected and guarded against.

He stated that for the future there are three health problems in the radioactive field. The first is accidents such as spillage, breaks, and their prevention. The second is unfamiliarity and insufficient knowledge of how to handle these materials. The third problem is that of chronic low-level exposure. Most investigators and workers will be using negligible amounts of radioactivity in tracer experiments and only simple precautions will be needed. However, when we calculate the sum total of all the radioactive isotopes used over the entire country, the serious character of the disposal problem becomes evident. Simply diluting the material and letting it pass into streams and rivers will not suffice.

The industrial chemical field is broadening too rapidly and too extensively for toxicological investigations to keep apace. Although many new products are being developed by manufacturers, the problem is to make certain that no new chemical is used in a manner in which systemic toxicity or skin irritation

might result either in workers making the product or in consumers.

For example, Dr. Kelly said that every new textile chemical developed by Monsanto is subjected to a laboratory study for such reactions culminating in patch testing on 200 human subjects. In plastics, animal experimentation, involving in some cases two-year feeding tests, must be made before they can be marketed. Some substances are so innocuous that they can be used in any application, while the use of others must be more limited.

In discussing the new use of the rarer metals such as vanadium, beryllium, tellurium, cadmium, and uranium, he said there is no common toxicological action or symptom associated with them. Little is known about some of these substances, because as yet they have been used in limited amounts in restricted work or have not been recognized as having distinctive physiological properties.

He also mentioned the use of high-frequency radiation popularly called microwaves. These radiations are the basis of the electronic field and have wide industrial application. It is important that their effect on the human being be determined.

Private industry and government agencies are spending annually on scientific research more than $1,200,000,000. This work will narrow the gap between visionary products of today and the activities of tomorrow and will furnish us a constant source of associated health problems.

Motor-Vehicle Suspension

A NEW development in motor-vehicle suspension design, providing two front axles arranged one behind the other and interconnected for steering and weight transfer, is described by J. W. Wunsch, member A.S.M.E., president and chief engineer, Silent Hoist and Crane Company, Brooklyn, N. Y., in the 1947 *Technion Yearbook*, a yearbook devoted to the advancement of technological training and research in Palestine and the Near East.

Mr. Wunsch writes that in the conventional single-axle two-wheel steering mechanism, the weight of the chassis is taken first on the chassis spring and then through the axle on the wheels. When semi-eliptic springs are used, for instance, these springs can serve not merely as suspension members but also as thrust members. In this design, one end of the spring is directly pivoted to the frame while the other end is shackled to the frame. In the design of the four-wheel suspension system the foregoing characteristics are retained, and several decided betterments with the introduction of an equalizing beam to interconnect the two front axles have been added. See Fig. 8. This equalizing beam (one on the right hand and one on the left) is pivotally mounted on the chassis frame and one end of the beam is shackled to the first spring, the other end to the second spring.

The practical necessity of two rear axles for load-carrying capacity has long been recognized in commercial motor-vehicle design. The limitations of the single steering axle are also understood although they have not been so pressing. We have just about reached the limit of the two-wheel front axle as regards stability, load capacity, and riding quality. The

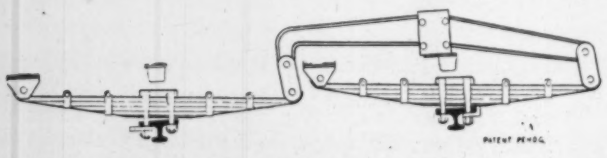


FIG. 8 EQUALIZING BEAM

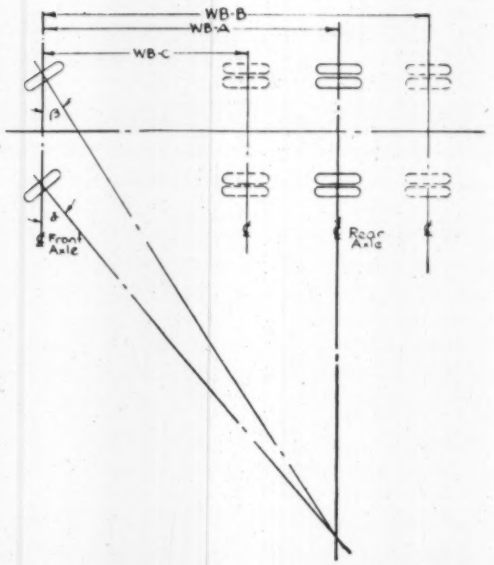


FIG. 9 STEERING GEOMETRY OF CONVENTIONAL TWO-WHEEL STEERING ASSEMBLY

dirigible, duplex, front-axle system is a very natural development therefore to obtain the maximum dynamic balance, engineering economy, and loading capacity from the structure, without dangerous abuse of some of the component elements.

According to Mr. Wunsch, the four-wheel suspension provides the possibility of ideal load distribution between the front- and rear-axle groups. An incident advantage is the lower unsprung weight which is very important in vehicle design. Low unsprung weight means less shock to axles, springs, frame, and steering elements. This low unsprung weight balanced between the front and rear axles (of the front end assembly) by the equalizer beam eliminates many notorious evils of two-wheel steering and offers important advantages in steering stability, riding quality, and better load distribution. Shock overloads are substantially reduced and never reach the dangerous proportions as in vehicles with single front axles. It is these shock overloads, more so than the static overloads, that cause axle troubles and extravagant maintenance of springs and steering-gear elements.

The steering geometry of the four-wheel front suspension is said to be elementary, commercially as practical and equal to the best single axle layout. Fig. 9 illustrates the steering geometry of the conventional two-wheel steering assembly. The ratio between the angle α and the angle β is built into the truck axle by the axle manufacturer and is a constant. On a truck wheel base A, the axis between the right- and left-hand front wheels intersects at a point on the center line of the rear axle. This is the perfect steering geometry, but very few commercial trucks attain this ideal wheel-base and front-axle proportion. Manufacturers vary wheel bases to suit their needs, without changing the front axle, so that they have a condition of oversteering on short wheel bases and understeering on long wheel bases. This oversteering or understeering is at its maximum when the wheels are cramped in the farthest psosition, either right or left, and at that time the truck is usually traveling at very low speed. When the truck is traveling straight ahead, the angle ratio is zero.

The steering geometry of the Milford Truck with four-wheel steering assembly is shown in Fig. 10. The ratio angle α and angle β is determined by the steering linkages and has been designed to give perfect steering of the left-hand wheels, when

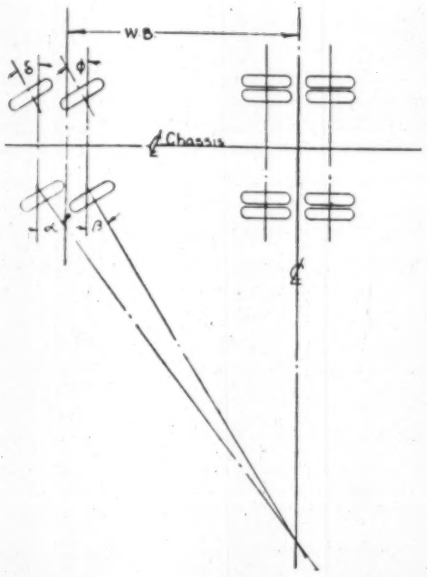


FIG. 10 STEERING GEOMETRY OF FOUR-WHEEL TWO-AXLE STEERING ASSEMBLY

making left- or right-hand turns. Angles δ and ϕ are determined on commercial axles are well within the range used on the conventional trucks.

Important advantages are inherent in the smaller tires of the four-wheel front-end suspension. The smaller tires are of course easier to handle, store, maintain, service, and replace at a lower unit cost. An important design advantage in the use of the small tire is that in steering-gear parts the bending moment at the root of the steering arm is substantially proportional to the load carried by the wheel and to the wheel diameter. Therefore steering-gear stresses are lower and lighter elements can be used.

Because the front loading is equally divided between two axles, smaller axles and lighter springs can be used which reduce the unsprung weight contributing to a much smoother ride with less impact to suspension brackets and frame. Since the frame is lifted only one half the height of any obstruction encountered by the wheels, due to the equalizer beam action, there will be less pitching and tossing of driver and load.

Standardized Turbine Generators

ACCORDING to an article by J. G. Partlow, generator engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa., the benefits of standardization have been brought to turbine generators. A recently redesigned family of high-speed, two-pole, industrial turbine generators is now available in ratings ranging from 100 to 7500 kw, inclusive, at 480 to 13,800 volts. These highly standardized units are intended to eliminate in so far as possible the need for building each turbine generator set as a special "tailor-made" unit and to promote "off-the-shelf" purchasing with its attendant advantages to both builder and user. About 25 per cent of the generators of these ratings are used by public utilities, but the remainder are applied to a wide variety of industries, both foreign and domestic, in the manufacture of paper, lumber, sugar, textiles, petroleum, and chemicals.

Standardization is the key to producing better generators without increasing the over-all cost. Each variation from the standard design, no matter how trival, usually entails additional engineering and construction work, which can increase the cost of the unit considerably. Once the design of the generators was standardized, many improvements were made in production methods, and, where applicable, simplified tabulated drawings were made for the ratings selected. Manufacturing is facilitated by the use of jigs and fixtures; for example, the component parts of the frame are premachined and accurately welded together in an assembly fixture. Thus the advantages of adhering to standard designs are being utilized to the fullest extent.

Although two-pole turbine generators have been built in ratings below 500 kw, units smaller than 1000 kw are usually of the geared salient-pole-type because of certain economies in this range. Therefore 1000 kw has been selected as the lower limit for the new line. The kilowatt and voltage ratings over the entire range of sizes are in strict accordance with the recommendations of the National Electrical Manufacturers Association.

The objective of the standardized industrial turbine generators is to add several desirable features without increasing the over-all cost. Accordingly, the new machines incorporate those features revealed by experience as most attractive to the majority of users. The over-all appearance is modernized and uniform in all sizes; the length of the units is reduced; accessibility to the collector and commutator is improved; exciter and collector are enclosed in a streamlined housing; exciter ventilation system no longer requires ducts through the foundation. Various accessories, such as an electric indicating tachometer, an exciter air filter, and clamp-type, solderless, terminal lugs are included as standard features.

Sound Generator

INDUSTRIAL application of sound waves has received new stimulus with the erection by Ultrasonic Corporation, Cambridge, Mass., of a unit to precipitate carbon black for Godfrey L. Cabot, Inc., according to the *Industrial Bulletin* of Arthur D. Little, Inc., for September, 1947. This pilot unit has been so successful that other industrial applications are being investigated.

The terms "supersonic" or "ultrasonic" are sometimes used to designate sounds too high in pitch to be detected by the human ear. Although ultrasonic sound has many industrial applications, the new carbon-black collection unit employs an extremely efficient generator of intense audible sound. The sound a few feet away from the new generator is more than 100 times as intense as the noise from a 2000-hp aircraft engine running "wide open" in a small room. Commercial production of such a sound is made possible by a siren which is capable of converting as much as 50 per cent of the available energy in compressed air into sound, whereas an ordinary fire-engine siren has an efficiency of less than one per cent.

Sound waves involve successive compression and rarefaction of the air. Because extremely small particles suspended in air tend to follow this movement, while larger particles remain relatively still, sound waves cause collision of the small particles with the large ones. Although the amplitude of these vibrations is extremely small—generally less than a thousandth of an inch—it is sufficient to give particles a push equivalent to twelve million times their own weight. Under proper conditions the dust particles will adhere to form aggregates containing as many as several hundred primary particles which may then be collected in a standard separator. In general, the finer the particles of a suspension, the more readily are they coagulated by the sonic method, hence greatest use will be in fields where the dust particles are smaller than ten microns, or about

as fine as face powder. The agglomerates of carbon-black particles issuing from the combustion chamber are in this range and the sonic apparatus reportedly collects them as efficiently as a dry electrostatic precipitator, with a cheaper installation. Other fields where the method appears promising are in the precipitation of acid mists and tar fogs, which are difficult to handle by other methods.

Natural fog is another problem that may yield to sonic precipitation, although work is still in the experimental stage. Preliminary tests for the Navy indicate that power consumption may be great, but is still only about one tenth the amount consumed as fuel by the "Fido" installation, which burns the fog away with flame.

Other physical and chemical effects of sonic and ultrasonic vibrations may be utilized for a wide variety of applications—a material may be dispersed into the colloidal state or coagulated from it, large molecules may be broken down into smaller ones, or certain chemical reactions may be accelerated. A short exposure to an intense sound field has accelerated the aging of whiskey, with a distinct improvement in odor and flavor. The operation of spray driers may be improved by an increase in the transfer of heat from the hot gas to the spray droplets. Investigation of the use of sound to improve the formation of sheets of paper by shaking the water out may lead to a similar application for the drying of textiles.

With the development of jet planes, which create high-intensity sound waves the physiological effects of sound are being investigated. The new generator will be used to determine human limitations and reactions. Although no lasting ill effects have been encountered from short exposure to high-intensity sound, nausea, headaches, and a painful sensation in the ears have been observed. There is also a temporary decrease in the sensitivity of the ear to the frequency to which it was exposed, comparable to the decrease in color sensitivity of the eye after staring at a certain color.

For those who picture the future industrial world as filled with screaming sirens, it may be noted that the shielding effect of the steel walls enclosing the sound generator is sufficient to lower the noise level outside the present pilot installation to that of a noisy business office.

Large Diesel Engine

ACCORDING to *Power*, October, 1947, the most powerful single-acting Diesel generating unit yet built in this country is being installed in the Pedro de Valvida power plant of Lautaro Nitrate Corporation, Ltd., Chile. With ten 29 × 40-in. cylinders and a normal rating of 7100 hp at 164 rpm this Nordberg engine drives a 5000-kw 6600-volt 3-phase 60-cycle General Electric generator to supply power for mining and processing nitrates. A duplicate is under construction for the Marshalltown, Iowa, plant of Iowa Electric Light and Power Company.

Design follows that of other Nordberg 2-cycle engines. Bedplate, cast in two sections and bolted, supports "A" frames carrying separate cylinder blocks doweled and bolted. Tie rods, tightened by special hydraulic jacks, take all tension stresses. Two 5-crank forgings form the crankshaft. The 2-piece pistons consist of cast-steel oil-cooled heads and skirts resting on crosshead flanges. Crosshead guides bolt to A frames. A 7-feed lubricator driven from a layshaft supplies each cylinder; general lubrication is full pressure.

The engine differs from other Nordberg 2-cycle units in location of the camshaft, which is overhead, and fuel pumps, which mount directly over the camshaft. Fuel-injection lines are thus short and direct. Engine controls are placed for convenient operation from the floor. A motor-driven blower furnishes scavenging air; automatic plate valves prevent backflow of gas and consequent contamination of incoming scavenging air.

Tests on engines of this type indicate a low fuel rate of 0.38 lb per bhp-hr, including power to drive the scavenging blower. Fuels of viscosity up to 1500 SSU at 100 F have been burned successfully.

Personnel Management

A STUDY of the steps taken by I. G. Farben, German industrial plant, to increase production by improving the quality of supervisory personnel, is included in an investigation of personnel management in Germany during the war years, sponsored as a project of the Engineering Foundation, New York, N. Y., it was revealed recently. The purpose of the study was to learn about German industrial practices which would be of value to American industry. A leading part in the research was taken by Dr. Morris S. Viteles, professor of psychology at the University of Pennsylvania, and Director of Personnel Research and Training, Philadelphia Electric Company, and was done under the auspices of the Technical Industrial Intelligence Division, U. S. Department of Commerce.

Dr. Viteles visited industrial establishments and educational institutions in eight German cities. He also had access to records on employee interviews, the supervisory training program, and questionnaires used in a selective psychological examination in the Farben plant at Ludwigshafen from 1939 until 1944, when work at the plant was stopped by the allied invasion. Information was also obtained through conferences with a former director of the plant's employee department, and with other psychologists and industrial engineers connected with the plant's program.

The research disclosed that from 1939 on, increasing use was made of psychological methods to select and train workers, with the emphasis on "characterological" examination, including reference to body type, handwriting, and similar factors.

According to the report, the I. G. Farben management recognized that increased production was being handicapped by the failure of supervisory personnel to stimulate employees' cooperation through appropriate leadership.

Consequently, a training program was undertaken for the 2000 supervisors. It included lectures on the history, organization, objectives, and personnel policies of the plant, and discussions of industrial hygiene and production. The major portion of the program was devoted to a discussion of psychological principles in the handling of personnel.

Actual cases were analyzed to show, for example, how knowledge of individual differences among employees could be used to advantage in handling the problem presented by a given employee. Other situations were chosen to illustrate the human drive for recognition and prestige and how this could be used to stimulate employees to better production and increased cooperation. Attention was given to methods for interviewing employees to find out why they fail, and to methods for conducting correctional and disciplinary interviews. Techniques for issuing and enforcing instructions were discussed in terms of specific case problems.

Approximately two thirds of the experienced supervisors undergoing such training expressed interest, and about one third showed improvement, in supervisory practices. These results suggested that, in the future, men for such positions should be selected on the basis of natural aptitude for and interest in leadership.

A program for selection of supervising personnel was then

developed to include questionnaires, tests, and a characterological analysis.

The questionnaires and tests were constructed to reveal the applicant's judgment as to his obligations in the plant and constructive use of leisure time; his originality and imaginative talent; his practical judgment in dealing with employees; his suitability for working with technical materials and equipment, people, and ideas, and his ability to size up people according to facial characteristics of certain body types.

While significant, the questionnaire and test results were considered less important than the findings growing out of the characterological analysis made by the psychologists on the basis of an interview, an examination of the handwriting, and a consideration of body type and of the speech and motor characteristics of the applicant.

An analysis of results showed that in 80 per cent of the cases recommendations of applicants for supervisory positions by top management were confirmed by the psychological examination. In approximately 25 per cent of the cases there was disagreement between the findings of the psychological examination and the judgment of the plant and department managers, but in one half of these latter, disagreements were resolved in conferences between the psychologists and the plant representative.

A report on this study has recently been published by the Department of Commerce, entitled, "Training and Selection of Supervisory Personnel in the I. G. Farbenwerke, Ludwigshafen."

Speed-Record Tires

ACCORDING to the September, 1947, issue of *Rubber Developments*, published by The British Rubber Development Board, the stress of war has by-passed an important centenary, for it is just over 100 years ago, in 1945, that Thompson took out his patent for the pneumatic tire. It is a most surprising thing that this invention was before its time and lay forgotten for several decades, for it was not until 1888 that J. B. Dunlop, a Belfast veterinary surgeon, conceived anew the idea of using a cushion of compressed air instead of solid rubber to lessen the vibration on his son's bicycle.

This early type of air tire affixed to the cycle wheel rim by means of tape was the forerunner of the modern pneumatic tire for motor vehicles, without which road transport as we know it today would be impossible. Another point that is so often overlooked is the establishment by farsighted British pioneers of rubber plantations in Ceylon, Malaya, and other Eastern territories, concurrently with the development of the internal-combustion engine. Had this not occurred, the motor industry could not have reached its present stage of development with the totally inadequate and unsatisfactory supplies of "wild" rubber from the Amazon valley.

The modern pneumatic tire, which is now taken so much for granted, represents the culmination of years of patient research and experiment—a process which still goes on and one which owes much to the intrepid seekers of new speed records. (The latest world land-speed record of 394.196 mph was established by John Cobb on September 17, 1947, at the Bonneville Salt Flats, Utah.) The car tires required for such a record must be capable of standing up to extremely high stresses and strains imposed by an anticipated speed of 400 mph, and 50 special tires were constructed for the car by the Dunlop Rubber Company at Fort Dunlop. Their size is 7.00 × 31—a moderate-size tire of 7-in. section on a large-diameter rim.

The most interesting and unexpected fact about the tires is that the tread is only $^1/_{50}$ in. thick, and, moreover, it is quite smooth, having no tread pattern. The reason for this is centrifugal force, for not only must the tires transmit the enormous thrust of the powerful Napier engines, but they must do this while subjected to extremely high internal stresses due to centrifugal force. In the average car, going at 50 mph, the centrifugal force is about $1^1/_2$ tons, to which any modern tire can stand up with ease. At a speed of 400 mph this force increases to 150 tons, which would pull off an ordinary tire tread in a few seconds.

Each of these new record-breaking tires is used for only about four minutes on a single run, when, as a precautionary measure, it is changed for a new tire. A comparatively thin tread is therefore considered sufficient to protect the casing fabric against abrasion and cutting by the salt bed.

From the rubber producer's point of view, the most interesting thing about these record-breaking tires is that only natural rubber was used in their construction.

Ceramic Coatings

COMBUSTION-CHAMBER liners and turbine buckets in gas turbines of jet-propelled aircraft now can have a longer life by being coated with high-temperature ceramic glazes, according to a talk given by Dr. Louis Navias of the General Electric Research Laboratory on a recent G-E Science Forum.

Dr. Navias declared that for combustion chambers using kerosene, a high-melting glass or glaze can furnish good protection to the liners. For gasolines containing lead, it is necessary to protect the inside surface of the combustion-chamber liner by means of a refractory coating, such as magnesia. For using a ceramic refractory tube as the combustion liner, alumina has been found to be one of the few high-melting oxides with the strength and the refractory properties for such an application.

He pointed out that these several ceramic coatings "show great promise" in lengthening the lives of combustion liners.

To coat the combustion liner when kerosene is the fuel consumed in aircraft gas turbines, the liner is cleaned by sandblasting, sprayed with a suspension of the glass powder, and then heated in a furnace to 1000 C to mature the glaze.

When magnesia is utilized to form the liner coating, in cases where gasoline fuels contain lead, the practical problem is that of anchoring the material in place to withstand the heat, the high velocity of combustion gases, and the corrosive nature of the products of combustion.

He said that some progress has been made also in using a ceramic refractory tube as the combustion liner, either as a single piece or in sections. Since the liner temperature may be 800 C, and may reach 1350 C at some hot spots, the thermal shock properties of the ceramic tube are quite critical. Alumina is one of the few high-melting oxides which has the strength and the refractory properties for such an application.

The life of metal turbine buckets, which must withstand the chemical attack of combustion gases, has been prolonged by coating them with a high-temperature ceramic glaze, applied very much in the same way as the glaze on the combustion liners. Care is taken to see that the thermal expansion of the glaze is not very different from that of the metal to which it is applied.

As the turbine operates, the glaze on the buckets is slowly vaporized, leaving but a very thin film after 100 hours of service. This thin film, however, is still effective for longer periods but no really good explanation for this peculiar behavior has been found.

According to Dr. Navias, laboratory scientists in this country have been trying to substitute a solid ceramic turbine bucket for the metal bucket. One of the best materials so far considered is fused crystalline alumina. In its most elegant form, a single

crystal of clear fused alumina is a sapphire. Alumina has a density of 4, whereas iron has a density of 8. Alumina buckets need therefore not be quite so strong as the metal buckets. They also have the advantage of lower weight.

Since the turbine wheel rotates at high speed, the buckets must withstand high centrifugal stresses as well. Speeds of 7500 to 20,000 rpm are not uncommon. It is not known yet whether solid ceramic materials can meet the demands of turbine buckets, and the final answer will depend upon numerous investigations now being carried on in several laboratories.

At present, thermal efficiency requires that the combustion temperature be at least 2200 C in the aircraft gas turbine's combustion liner, which is a perforated tube of metal, in one instance 6 in. in diameter and 20 in. tall. The present type of combustion liner is kept at about 0.04 in. in thickness, and is made of heat-resisting steel. Because of high heat stresses, the metal liners warp badly, and when kerosene is used, the combustion products cause erosion and scaling on the metal liners. The conditions are much worse when ethyl gasoline containing lead is the fuel.

Liquid Springs

LIQUID springing, writes A. E. Bingham, in an article in *Engineering*, September 26, 1947, is now generally understood in the aircraft industry, but it is little known in the broader field of general engineering. Engineers know that nothing is incompressible, which is another way of saying that nothing is perfectly rigid; but the degree of rigidity or compressibility varies greatly in the wide range of materials now used. Compressibility must not be confused with deformability; it is easy, for example, to deform rubber and similar materials, but a high pressure is required to reduce their bulk to any considerable extent. It is unfortunate that the phrase "liquids are incompressible" is commonly used, for the phrase is fallacious.

According to Mr. Bingham, in 1906 P. W. Bridgman started 25 years' work at Harvard University, the results of which were published in his book "The Physics of High Pressure." It covers a vast field, only part of which is applicable to liquid springs. This work formed the foundation of the specialized research necessary for the development of liquid springs. The aim of the physicist is to obtain the absolute compression of the fluid at increasing pressures and at various temperatures. Many methods are described in considerable detail in Bridgman's book, and still others are given in Prof. D. M. Newitt's "High Pressure Plant and Fluids at High Pressure."

Mr. Bingham states further that in 1938, the compressive properties of a number of fluids already known, Mr. George H. Dowty conceived the idea of using a liquid as a springing medium and, at the same time, using that same volume of liquid as a dashpot medium. His first patent covering the system was taken out in 1939. From that date onward, intensive research was carried out by his firm, Messrs. Dowty Equipment, Limited, and the ways of the physicist and the engineer began to divide. In the physical laboratory, the life of the high-pressure gland is immaterial, but, in applying the physical phenomena to engineering practice, the life of the gland is all-important. Leakage must be reduced practically to zero and friction must be within reasonable limits. These two conditions are opposed.

The first experimental cylinder is shown in Fig. 11. Its main dimensions were: internal diameter $^3/_4$ in., external diameter $1^1/_2$ in., plunger diameter $^{13}/_{32}$ in. The gland consisted of a simple disk of synthetic rubber with a substantial diametral interference in the housing and on the plunger. This sealed satisfactorily up to 20,000 psi. Many types of glands were tested in a great variety of geometric forms and a wide range of materials. Hardened steel plungers were tried, but subsequently all plungers were made of ductile steel.

Interest turned to synthetic glands with various types of reinforcement. Improved sealing resulted, but frequently it was difficult to dismantle the apparatus after attaining pressures of 30,000 psi or more. The trouble was traced eventually to the trapping of pressures in the gland assembly, and a solution was found by introducing a foraminated layer between the gland and the washer. This consists of two layers of fine-mesh wire gauze, set so that the respective meshes are at 45 deg to each other.

To design a gland which will not leak at high pressure is simple, provided that friction and wear can be ignored. Alternatively, if a small amount of leakage can be tolerated, friction can be reduced to a low figure. For a liquid spring, a compromise is required. The solution was found in the "unsupported area" type of gland (British Patent No. 539,966).

The pressure acts over the full annular area of the gland assembly (four pegs being rigidly attached to the inner washer); and the gland-ring area is the full annular area less the area of the pegs. As the total force in each direction must be balanced, the pressure in the gland ring must be higher than the oil pressure; therefore leakage is eliminated. To prevent extrusion of the gland through the working clearances round the piston rod and pegs, chamber rings are provided, made of a tough bearing material. The amount of out-of-balance area has been determined by experiment. The gland is on a synthetic base reinforced with fabric. The backing washer has relief grooves communicating with the peg holes to prevent an accumulation of pressure, which would destroy the out-of-balance condition.

For calculating the strength of thick cylinders, Lamé's formula, which has been verified for this class of work by photoelastic methods, is used. In 1939 and 1940, a number of bursting tests were carried out on cylinders and, in every case, the bursting pressure was considerably higher than that calculated by this formula. The reason for this is that, when the plastic range is reached, there is a redistribution of stress and the difference between the stress at the inside diameter and that at the outside diameter is reduced. This provides an added factor of safety. In all these tests, failure occurred as a simple split, parallel to the cylinder axis. Long-term fatigue tests indicated the importance of good surface finish, and of the elimination of sharp corners. When a cylinder fails there is no danger to personnel because no metal is projected;

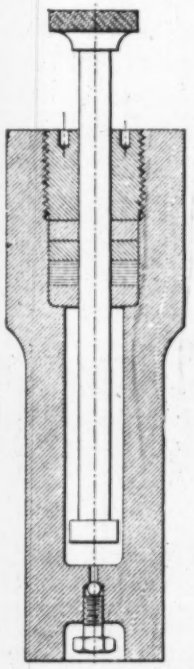


FIG. 11 FIRST EXPERIMENTAL LIQUID SPRING

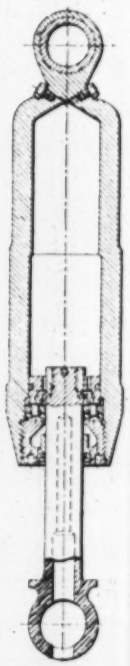


FIG. 12 LIQUID SPRING USED ON BOMBER

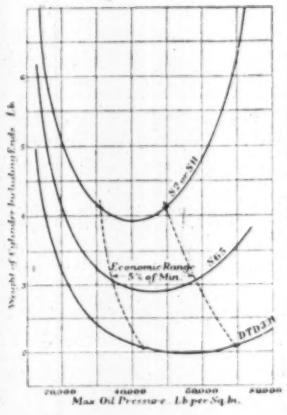


FIG. 13 OPTIMUM PRESSURES FOR VARIOUS STEELS

with liquid as the pressure medium, the stored energy is comparatively small.

In the design of cylinders, prestressing, multiple sleeving, and wire winding have all been considered and abandoned as uneconomic. For the same volume of liquid, the weight of the barrel portion is unaffected by the length-diameter ratio, but for short cylinders the ends are heavier, so it is an advantage to make the cylinder as long as possible.

The compressibility of all fluids decreases with increas-

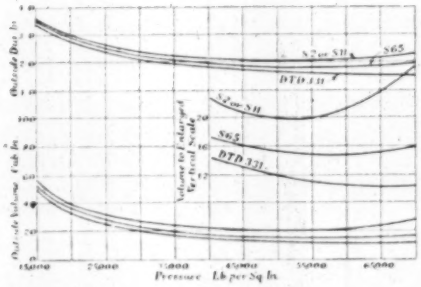


FIG. 14 CURVES RELATING TO EXTERNAL VOLUMES FOR THE SAME CYLINDER AS IN FIG. 13

ing pressure and the strength efficiency of a plain cylinder decreases with increasing pressure. Fig. 13 has been plotted to determine the optimum pressures for various steels, in the case of a cylinder with a 5-in. barrel and 3-in. stroke, to support a load of 10,000 lb. The design is based on the thick-cylinder theory, the stressing pressure being 4/3 of the realized pressure. The three curves shown all drop to a minimum and then rise again steeply. The economic range has been chosen, arbitrarily, as being within 5 per cent of the calculated minimum and, for the steels quoted, the critical range lies between 45,000 and 50,000 psi. Fig. 14 gives a similar series of curves, relating to external volumes, for the same cylinder as in Fig. 14. These do not rise so quickly after the minimum is reached.

The direct stress in the plunger is the same as the fluid pressure and, as there are also bending and strut effects, stressing problems are difficult with pressures above 50,000 psi. Taking these points into consideration, together with the fact that gland wear increases as the pressure rises, there is little to be gained by using pressures above 50,000 psi.

In a liquid spring which also acts as a shock absorber, a dashpot function must be incorporated. In shock absorbers for aircraft and similar applications, the dashpot orifice is controlled so that the recoil velocity is less than the compression velocity. Fig. 12 shows a section through a liquid spring used on a Handley-Page Halifax bomber. The piston carries a ring valve which lifts on the compression stroke, opening all the orifices. On the recoil stroke the valve closes all but one of the orifices, so that the recoil stroke is much slower than the compression stroke. The shape of the stroke-reaction curve is important, especially if comfort is involved; a too efficient shock absorber on an aircraft or road vehicle can give too great a change in acceleration, leading to unpleasant sensations. It may be mentioned that the piston has no influence on the compression of the liquid beyond the comparatively small effect due to differential pressure.

Atomic Physics Division

THE National Bureau of Standards has formed a Division of Atomic Physics in which the main Bureau activities relating to atomic and molecular physics have been grouped together, according to an announcement by Dr. E. U. Condon, Director of the Bureau. The new division includes most of the basic lines of activity which made it possible for the Bureau to co-ordinate and direct, under its Presidential directive, the activities of the atomic-bomb project from its inception in the fall of 1939 until 1942 when it developed into a large-scale industrial undertaking.

The functions of the new division are the promotion of fundamental fact-finding research and the precise determination of important fundamental standards in the field of atomic physics. This research will be applied to the establishment of primary and secondary standards of reference as, for example, calibrated sources of radiation or meters for dosage, and the calibration of instruments used in atomic-physics studies. It is also responsible for the development of protective and safety codes for the reduction of industrial hazards arising from new applications of physics and for the study of materials and equipment for the protection of the interests of the Government as a large consumer. Six sections make up the new division: Spectroscopy, Electronics, Mass Spectrometry, Radioactivity, X rays, and Atomic Physics.

High-Speed Camera

A NEW motion-picture camera which, it is claimed, will take more than 5 million pictures per second, was described at the annual meeting, Cincinnati, Ohio, October 25, 1947, of the Optical Society of America, by Dr. Brian O'Brien and Gordon G. Milne, Rochester Institute of Optics, University of Rochester.

The camera is said to be ten times as fast as any previously made and is expected to reveal new scientific information about electrical charges, high explosives, and shock fronts important in the study of supersonic flight.

Exposure by conventional means at speeds of several million frames per second would require a film movement through the camera at 20 to 50 times bullet velocities. If instead the film is stationary and the image caused to move by means of moving optical parts such as rotating mirrors, the total number of frames and thus the total duration of the motion picture becomes quite limited. Moreover, rotating mirrors or their equivalent impose serious limitations upon the optical system, and usually limit the relative aperture of the objective lens and make it difficult to secure sufficient illumination on the film for adequate exposure at high speeds.

The foregoing difficulties are avoided if the image of the rectangular picture is broken up into a series of very narrow strips which are then reassembled, end to end, into one long narrow strip. In the new camera this image dissection is accomplished by a stationary optical system of somewhat unusual properties, and the single long and narrow strip made up of the dissected elements of the original picture is imaged on the negative film as a line so narrow that it is less than the resolving power of the film itself. The film is driven past this line image, and in a direction perpendicular to the line, at the comparatively high speed of 400 fps. This is accomplished

by containing the film on the inside of a shallow rotating drum where it is held in position by centrifugal force 16 thousand times gravity.

The narrow strip image is drawn out by the moving film into a streak, and the variations in photographic negative density at any place across this streak contain all the elements of a complete rectangular picture for the particular instant of time represented by the position selected along the streak. The negative film need move by only the width of the narrow slit image to produce a complete new frame of the original rectangular event or picture. Since the camera is shutterless the motion of the film produces a blurring of the image, but this blurring is limited to the width of the slit which is no more than the resolving power of the negative film itself.

After processing, the negative must be reconstructed into the original rectangular picture by projection back through an optical system similar to that which formed it. This is done by an automatic projection printer which produces an ordinary 16-mm motion-picture print which can be run through an ordinary projector. In the present camera the negative is enlarged tenfold in printing back to a 16-mm motion-picture frame. Thus the film grain imposes a serious limitation on picture quality although the resolving power secured is adequate for the study of many subjects. The nominal rating of the present camera is 5 million frames per sec, but the behavior is still satisfactory at higher speeds. The exposure time is approximately one seven millionth of a second, but because of the peculiar arrangements of the optical system and film the interval between frames can be less than the exposure time while still preserving the continuity of the picture.

Because of the compact character of the negative-film record, continuous runs of a large number of frames can be made.

Pumice Concrete

PUMICE concrete, developed in the western volcanic region, is a material said to have many unusual qualities, and is described in the U. S. Navy *Civil Engineer Corps Bulletin* for October, 1947.

According to the article, pumice concrete is made with Portland cement, water, sand, and pumice rock. Instead of sand, crushed pumice rock is sometimes used, depending upon the properties desired in the resulting concrete. Proportioning, mixing, and placing are done in a similar manner to that employed for conventional concrete, except for wetting of coarse aggregate prior to mixing to obtain the "plus" values of pumice concrete.

Pumice is a highly vesicular glass produced by nature in prehistoric times by the extravasation of the water vapor at high temperatures. It is a volcanic glass froth composed of a mass of silky interlocking fibers of cottony appearance, full of pores, and light enough in weight to float on fresh water. The purer deposits that are free from clays, volcanic ash, and dust are found in the Coso Range in southeastern California. These deposits yield grain size and particles that fall within specified gradation of the A.S.T.M. for concrete aggregates.

Pumice concrete is used in the same manner, in the same places, and for the same structures that sand and gravel concrete is used. Because of its lighter weight, low thermal conductivity, moisture-adsorptive property, sound-damping effect, and the ability to hold nails or be cut with a saw, it is frequently specified where conventional concrete is not applicable. It is mixed with the same equipment, using the same materials, except for the pumice. It is placed, screened, troweled, and finished by the same craftsmen who work the heavier sand and gravel concrete.

Dwellings, bridge decks, pontoons, industrial and commercial buildings, basement walls, fireplaces, machinery pits, and refrigerator rooms represent natural applications of this lighter-weight fire-resisting, shockproof material.

Structural strength varies with the proportions of water, cement, pumice rock, and sand in the mix. Uniformity of materials and rigid control permit the design of concrete having any specified crushing strength from 1500 up to 3200 psi.

Weight of concrete increases with increased specified strength, but even in the higher brackets the saving in dead weight of pumice concrete is 25 per cent over sand and gravel concrete. This is reflected either in increased live-load carrying capacity, or in economy in reinforcing steel. The strength is determined by proportioning the components. The aggregate that is put into the pumice concrete floats in fresh water. The weight of a cubic foot of concrete increases with the amount of cement and sand used and is not dependent upon the amount of pumice in the mix.

Unlike ordinary concrete that explodes and disintegrates under intense heat, pumice concrete has been heated to fusion without exploding or spalling. Full-size tests were conducted in 1945, where reinforced concrete and reinforced-pumice concrete dwellings were filled with gasoline-soaked sand and ignited. The conventional concrete exploded and spalled, exposing the reinforcing steel which was also damaged by the intense heat. The pumice concrete dwelling remained intact, showing only a black discoloration. The experiment was repeated with the pumice-concrete dwelling when four streams of water were played on the conflagration at its maximum intensity. Subsequent inspection showed no structural damage to the pumice concrete.

Low thermal conductivity makes pumice concrete an excellent material for refrigerator rooms, roof slabs, or walls of buildings exposed to extreme summer temperatures. The porous nature of pumice makes it an ideal material for absorbing, rather than reflecting sound waves.

T.V.A. Apprentice Training

HOW the many-sided apprenticeship program at the Tennessee Valley project is conducted is described in a 67-page report recently published and made available free of charge by Apprentice-Training Service, U. S. Department of Labor, Washington 25, D. C. This program, which covers 15 crafts in all, has been in operation since 1938.

As explained in the report, the program is administered by a central joint management-labor committee, co-operating with local committees in each trade. Apprentices are trained for craftsmanship as bricklayers, carpenters, plumbers, steamfitters, painters, sheetmetal workers, iron workers, electricians (construction, substation, and linemen), machinists, boilermakers, gas and Diesel-engine mechanics, auto body repairmen, and office appliance maintenance workers.

Included in the report is an explanation of the functions of the central and craft committees; qualifications, selections, and tests of applicants for training; work processes in which apprentices are trained on-the-job; classroom curriculum; time required in each step of the training; apprentice wage rates and veterans' benefits under the G. I. Bill; periodic examinations; ratio of apprentices to journeymen; apprentice record-keeping system; apprenticeship agreements; and certificate of completion.

The report contains 14 exhibits including administrative and organization charts, sample record-keeping forms, work-process analyses, and statistics of apprentices in training since the program was first established.

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Where Marx Went Wrong

To the Editor:

The address of C. E. Wilson,[1] contains numerous errors and misstatements which place it considerably below the level at which the serious problems involved should be discussed. This writer does not claim to be an expert on capitalistic and Marxist economics. He is also limited by lack of space. Consequently, all he can offer is to touch some of the high points of the address as a careful reader who watches events in this field with an open mind and open eyes.

The statement that "such attainments cannot be explained on the grounds of greater natural resources in the United States . . . Our political system is the single important factor which makes the difference between our country and others" is baseless and against common sense when considering that the peoples of France (population 198 per sq mile) and of Switzerland (225 per sq mile) enjoy the same political and economic freedoms as those of the United States, (population 42 per sq mile) not to mention the much greater coal, iron, oil, etc., deposits per capita. Several other countries of Europe are practically just as democratic as the United States, the only difference being that they have kings, who, however, are only figureheads.

According to the address: " . . . without some incentive, capital would not be accumulated." The Soviet Union accumulated enough capital to raise its steel production from 4,000,000 tons per year in 1913 to 20,000,000 tons in 1939. Also, as far back as 1931, Mr. John Carmody, then vice-president of the McGraw-Hill Publishing Co., delivered a lecture before the A.S.M.E. about elaborate incentive methods and the Stakhanovite movement in the Soviet Union on the basis of first-hand experience.

As a source of definitions for any serious discussion Webster's dictionary is far from being sufficiently analytical. Its definition of profit, "excess of returns over expenditure," quoted in the address, is only the bookkeeper's definition. According to almost every textbook on economics published here and abroad, "profit is the reward of risk" (risk of money, and not of life and limb). This definition is also contained in the Code of Ethics of the Chamber of Commerce of the U.S.A. It also indicates that engineers and manual workers have as incentives raises in salaries and wages, bonuses, premiums, and the like, but not profits. It answers the question, "To whom goes the profit?" while Marx, John Stuart Mill, and others claim to give the origin of it in the surplus value.

To invoke in this connection the Founding Fathers is like quoting James Watt in connection with a problem concerning a 1000-hp uniflow engine operating at 400 psi and high superheat. In the days of the Founding Fathers there was no mass production; 80 per cent of the population were independent and only 20 per cent employees. Today exactly the reverse is true.

Marx never discriminated between manual and intellectual work.

The phrase, "Marxist philosophy whether it was communism, Fascism, or some other form of statism," does not correspond to the facts. According to "Marxist philosophy" the means of production are nationalized. According to Fascism they are not; besides, nationalized plants are "reprivatized." In Fascism the "control of industry by the state" does not mean that the profits go to the state. The latter helps only to plan and co-ordinate and to maintain monopolies, eliminating thereby the greater part of the risk but not the profit. There was an active stock exchange in Nazi Berlin and in Fascist Rome; there is none in the Soviet Union.

Where Marx went wrong was where he declared that "the rich will get richer and the poor will get poorer," which may lead to a quiet or violent revolution. Due to technological improvements even the poorest have become less poor since Marx' time, although the extremes between richest and poorest may have become greater. These improvements have an alleviating effect that is sufficient to exclude in most cases the tendency toward revolutions, and, if properly handled in the economic field, and if developed at an accelerating pace, will possibly, even probably, counteract such revolutionary trends in the future.

On the other hand, the ever-recurring depressions of increasing violence destroy much of the salutary effect of technological progress. In addition to handicapping material production and with it the further developing of the basis of human happiness, one of the most harmful effects of depressions is the demoralization of labor through the constant dread of unemployment, leading to all the practices of slowing down production. Here some economic planning and co-ordination might do some good, whether some people would call it foreign or domestic, Marxist or Fascist, or not. This idea is represented in our country, among others by the National Planning Association, headquarters in New York, which consists of some of the most serious representatives of finance, business, industry, and labor.

All in all, the question of socialism or communism or both is too serious to be discussed in a manner not absolutely thorough, especially before an audience of engineers. It might even be more fair and convincing to arrange such discussions in the form of debates, with both parties represented, and with the possibility of discussions from the floor.

Andrew A. Bato.[2]

To the Editor:

In his Chicago address,[1] C. E. Wilson endeavors to show " . . . Where Marx Went Wrong." Since many countries of the world today have adopted socialistic programs, we might profitably inquire why they still follow Marxian theories if such ideas are now known to be delusions.

Most of us, both proponents of capitalism and of socialism, will agree with Mr. Wilson's fundamental faith — belief in the dignity and richness of individual personality. Marx was led to his proposals for a socialist society as a result of his observations of both the degradation of humanity by the industrial organization of his day and the failure of

[1] "The Great Delusion—Where Marx Went Wrong," by C. E. Wilson, Mechanical Engineering, vol. 69, no. 8, August, 1947, pp. 658–662 and 665.

[2] East Orange, N. J. Mem. A.S.M.E.

that organization to exploit effectively the potentialities of the machine and the available labor power.

Contrary to what Mr. Wilson claims, the poverty of the past century was not due to the low productivity of the workers but to the frequent periods of depression with attendant unemployment. If the shortage of goods was due to scarcity, then one would expect that everyone would be working full time in an effort to produce the necessities of life. Such was not the case. Charles Beard in his "Basic History of the United States" estimates that two thirds of the years between 1800 and 1870 were what we term "depression years." Business cycles in England closely paralleled those in America, despite the differences in the outward appearance of the two economies.

Marx describes the conditions of the unemployed during these depressions in terms which are strikingly familiar. Public relief, work projects, committees of the unemployed all sound reminiscent of twenty-nine and the early thirties in America.

The problem of business cycles is not one which can be put aside for even a short while. The argument that the worker in America is better off during a depression than a man at the same trade in Soviet Russia during the most fruitful period of communist growth, does not carry any weight with a man out of a job. He is not compensated for his loss of dignity and security by the convenience and comfort of radio, telephone, and electric appliances. He is branded a failure—often by his own family. Young people out of school and unable to find a job feel that the world does not want them. They do not seem to belong. They readily respond to the appeals of a demagogue and, as in Germany, a new despot comes to power. The arguments of Mr. Wilson could have availed little against the promise to the unemployed of jobs and security.

Mr. Wilson places considerable stress on the danger to freedom of the common man by the abolition of private property. The concept of complete communal ownership is not Marxian—it is a feature associated with various religious movements. The early Christians took literally the words of Christ and gave up their individual belongings. But no Marxist today advocates abolition of personal property. Some of the outstanding champions of democracy, men who have sacrificed their freedom and fortunes for their beliefs in human rights, are followers of Marx. Leon Blum in France and Jawaharlal Nehru in India are two who come to mind. Don Sturzo, who ranks with them in his championing of freedom, is not a Marxist but nevertheless opposes capitalism and favors social ownership and control of the means of production.

These men all recognize the danger of the totalitarian state. They have examined the workings of capitalist societies and consider them wanting. If the argument is to be won by proponents of capitalism it will only be on the basis of the better life in capitalist society—not so much material well-being as moral, religious, and cultural well-being. That we have yet to demonstrate.

DAVID ARONSON.[3]

[3] Chemical Engineer, Greensburg, Pa.

Smoke Abatement

COMMENT BY C. A. GOSLINE[4]

The author has presented an effective outline of the complexity of the many special factors which must be given attention if any smoke-abatement program is to satisfy its own purposes.[5] A problem of such magnitude requires the time of several specialists plus unique instrumentation, careful analysis of the data collected, sound enforcement practices, and expenditures of fairly large sums of money. Probably many cities defeat their own purposes by failing to give proper attention to all phases of the problems, especially the latter.

Some exceptions are taken to portions of the paper, namely, the cause of the Meuse disaster, the flow of smoke under inversion conditions, and, in the light of recent work by Schaefer and Langmuir, the nuclei theory of condensation:

1 Development of fluoride chemistry subsequent to the Liege tragedy led K. Roholm to believe that the deaths, etc., were primarily due to the presence of fluorides rather than SO_2, SO_3, and weak H_2SO_4 mist.

2 The writer's experience has been that smoke and vapors issuing from a stack under inversion conditions will remain at or slightly above the level at which they are emitted, assuming the wind speed is at least 5 mph. The "filling up" is the end result, but the initial distribution is many individual layers at different heights and these gradually merge. Even so, one can probably observe long ribbons of smoke within the general cloud, provided he is at a good observation point such as the upper stories of an office building.

3 Vincent Schaefer and Irving Langmuir of General Electric, have conclusively demonstrated that solid particles are not necessary and do not serve as nuclei for ice-crystal formation from supercooled water clouds.

Actually, solid particles of ice serve as centers for growth or agglomeration of ice particles and this results in crystal clusters. However, the original state is in the liquid phase; these minute droplets of supercooled water change to minute ice crystals which rapidly grow and multiply.

COMMENT BY HANS NEUBERGER[6]

The author is to be highly commended for his able summary of the factors involved in air pollution and smoke abatement, particularly for clearly pointing out the complexity of this problem which, in the writer's estimation, is almost insurmountable. This is the first time that the need for interprofessional co-operation in attacking this problem has been duly stressed.

Attendance at city council hearings pertaining to smoke-abatement ordinances is very discouraging because despite this century's great scientific and technological progress, the general attitude toward smoke abatement is so utterly unscientific and naive, that most people sincerely believe that air pollution can simply be legislated out of existence. This paper should be made required reading for all individuals and organizations concerned with smoke abatement, so that they may at least acquire, if nothing else, due respect for the magnitude of the problem and that they may discover that here is, literally, more than meets the eye.

It is realized fully that within the scope of the paper, the meteorological factors could not be treated in too great detail, and their discussion must, of necessity, be simplified. However, the matter of atmospheric stability warrants further comment, not so much for the sake of elaborating on this important subject, but rather to show that even this relatively simple matter may have its complications.

The increase of temperature with alti-

[4] Chemical Engineering Section, Engineering Research Laboratory, E. I. du Pont de Nemours & Company, Wilmington, Del.

[5] "Factors Rarely Considered in Smoke Abatement," by H. F. Hebley, MECHANICAL ENGINEERING, vol. 69, April, 1947, pp. 281–287.

[6] The Pennsylvania State College, State College, Pa.

tude was defined as an inversion. While this condition is thermodynamically stable, as is one in which the temperature remains constant throughout a given layer, a condition in which the temperature decreases with altitude is not necessarily unstable. Nonsaturated air (relative humidity less than 100 per cent) is stable if the rate of temperature decrease with altitude is less than the dry-adiabatic rate of $5^1/_2$ deg F per 1000 ft. Saturated air is stable when the temperature decreases with altitude at a rate which is less than the moist-adiabatic rate of roughly 3 deg F per 100 ft. The latter depends upon air temperature and pressure. At any rate, the degree of stability, i.e., the degree of resistance of air against vertical displacement, is greatest in the case of an inversion, and air pollution has its greatest concentration in the case of a ground inversion, i.e., an inversion layer resting on the ground. This condition is usually connected with calm or light winds. Moderate or strong winds are usually associated with dynamic turbulence which, in turn, tends to establish an adiabatic rate of temperature decrease in the turbulent layer with an inversion above. In other words, the effect of fresh winds is to lift inversions off the ground. The persistence of inversion layers which may have formed during a clear night, is greater in valleys than in open country because the surrounding mountains act as a shield against the effect of the wind. Many industrial cities, unfortunately, are located in river valleys, a fact which aggravates the pollution problem.

In general, given industrial sources of air pollution, the concentration of suspensions and fumes in the lower air layers is governed by weather and topography.

COMMENT BY W. F. DAVIDSON[7]

First, the writer should like to express to the author his appreciation for the clear way in which he has discussed a very complex problem. All too often we are plagued with the ill effects of oversimplification carried out by people who have not taken the trouble to make a thorough analysis and so to know what may be simplified and what must be kept in the problem.

Second, it is suggested that at least a little more attention be directed to the Owens automatic filter. In its original form it was somewhat limited in its usefulness by the need for a regular water supply, but by a relatively simple redesign[8] it has been made in a form that permits of electric drive with charts suitable for a forty-day record. In that revised form it proved very useful in an air pollution survey made in New York, N. Y., some years ago.

Third, the survey just mentioned has been summarized in a paper published in 1942.[9] One tentative conclusion reported there was that the concentration of suspended solids varied as the minus 0.5 power of the wind velocity. A more detailed analysis of the data gives a value of the exponent for June conditions of —0.42 and for November and December conditions, —0.65. These compare with values of —0.4 and —0.7, respectively, reported for the survey at Leicester.[10] Several theories of atmospheric turbulence and air mixing would lead to exponents of this same order of magnitude, thus, seemingly, providing some confirmation of important parts of the author's analysis of the mechanisms of atmospheric pollution.

AUTHOR'S CLOSURE

Replying to Mr. Gosline's comment, the purpose of the paper has been fulfilled in that it has stimulated thought on the complexity of the problem of atmospheric pollution. The Meuse disaster as quoted was attributed by some of the doctors who studied the phenomena, to dilute sulphuric acid. If Roholm in subsequent work discovered that the fatalities were due to fluorides rather than sulphuric acid and sulphurous acid, such work accentuates the complexity of air pollution associated with industrial cities in which the waste gases are released in valleys during a period of adverse weather conditions.

The manner in which the gases of combustion will reach a certain level and then drift off in a ribbon is partly induced by the stability of the air and the temperature lapse rate of the atmosphere at certain levels.

The studies dealing with supercooled water at high elevations have an extremely interesting influence on fog or cloud formation, and the writer is glad that the point has been amplified by the commentator.

Dr. Neuberger's comments are welcome in that they amplify the problem of atmospheric stability. His whole comment stresses the complexity of the problem and the fact that it cannot be solved by legislation and emotional agitation.

The comment by Mr. Davidson mentions an article describing the work of measuring air pollution in New York, N. Y. For those who wish to study the subject further, it will be profitable to read the text in the *Monthly Weather Review*, Vol. 69, 1941, published by the U. S. Weather Bureau.

In conclusion, the author wishes to thank the commentators for their constructive discussion.

HENRY F. HEBLEY.[11]

[7] Research Engineer, Consolidated Edison Company of New York, Inc., New York, N. Y. Fellow A.S.M.E.

[8] "Automatic Dust-Sampling and Analyzing Instrument for Atmospheric Pollution Surveys," by W. F. Davidson and Warren Master, *Monthly Weather Review*, vol. 69, 1941, pp. 257–260.

[9] "A Study of Atmospheric Pollution," by W. F. Davidson, *Monthly Weather Review*, vol. 70, 1942, pp. 225–234.

[10] Department of Scientific and Industrial Research, "Atmospheric pollution in Leicester —A Scientific Survey," Tech. Paper No. 1, Atmospheric Pollution Research, H. M. Stationery Office, 1945.

[11] Pittsburgh Consolidation Coal Company, Pittsburgh, Pa. Mem. A.S.M.E.

Stress Determination

COMMENT BY A. J. DURELLI[12]

The determination of residual stress by drilling a small hole on the surface of the specimen to be studied is a particularly important contribution to the solution of a rather difficult problem.[13] The technique is essentially the same as that suggested in photoelasticity by Tesar.[14] The boundary conditions, however, are different.

The isochromatic patterns[15] for several combinations of principal stresses help considerably to give the correct interpretation to the photoelastic results. The isostatic patterns were determined for only the elliptical hole[15] because at the time the results for the circular hole were published, the brittle-coating techniques were not yet developed sufficiently.

Calling isoentatic the loci of points of equal principal strains, isoentatic patterns for all combinations of principal

[12] Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

[13] "Stress Determination by Brittle Coatings," by Greer Ellis, MECHANICAL ENGINEERING, vol. 69, July, 1947, pp. 567–571.

[14] "La photoélasticimétrie et ses applications dans les constructions aéronautiques," by V. Tesar, La Science Aérienne, Paris, Sept.-Oct., 1932, p. 372.

[15] "Stress Distribution Around a Circular Discontinuity in Any Two-Dimensional System of Combined Stress," by A. J. Durelli and W. M. Murray, Proceedings of the Fourteenth Eastern Photoelasticity Conference, Dec. 6, 1941, p. 26.

stresses around the hole would facilitate considerably the determination of the value of the residual stresses. This is a rather easy determination when the load is applied by steps and the isoentatics shown, as in Fig. 1 of this comment.

Tesar's method, as well as the one the writer developed with Dr. Murray,[16] gives the values of both principal stresses which were on the point before the hole was drilled, assuming a uniform field of stress. If the field is not uniform, an error is introduced which probably is not large if the stress gradient is not high, if the hole is small, and if the readings are made near the hole. The same observation should be applied to the author's suggestion of determining the amount of the residual stress by the number of diameters of the hole that a regular pattern appears away from the edge of the hole.

In this paper the assumption is made that the coating breaks according to the constant strain law. This assumption is general since the first paper published by Dietrich and Lehr.[17] The assumption, however, is only partially correct. When the strain is produced by a transverse stress (Poisson's effect) only, the coating does not break. Some recent Armour Research Foundation tests soon to be published show that the coating may be subjected to strains 10 times larger than the sensitivity strain without failure.

When both direct load and relaxation tests are possible, the accuracy may be greatly increased. Instead of using the apparent stress, or unidimensional stress formula $\sigma = E\epsilon$, whose maximum possible error is 50 per cent, the general formulas

$$\sigma_1 = \frac{E}{1 - \eta^2}(\epsilon_1 + \eta\epsilon_2)$$

$$\sigma_2 = \frac{E}{1 - \eta^2}(\epsilon_2 + \eta\epsilon_1)$$

should be used when both sets of isoentatics are obtained. These formulas are exact. In zones where only one set of isoentatics can be obtained, the unidimensional strain formula

$$\sigma = \frac{1}{1 - \eta^2} E\epsilon$$

gives a maximum possible error of only 37.5 per cent of $E\epsilon$.

To increase the sensitivity of the coating, the author sensitizes it by applying the etchant solution to the coating while the structure is under load. The writer had the opportunity of using this technique in 1941 at the Massachusetts Institute of Technology. It would seem that this technique gives more accurate results than chilling the coating as Gadd[18] does. The refrigerating technique is extremely useful for the determination of the isostatics. It was used to make the coating break in points situated from isoentatic 40 toward the outside of the ring in Fig. 1. To determine the values of strain, however, the law of variation in function of the temperature, time, and the initial strain should be determined previously.

A correct heat-treatment of the coating during the drying period may increase the sensitivity considerably. The writer has often been able to obtain sensitivities of the order of 0.0003. Although the dispersion of values is somewhat increased this way, this method is likely to give more accurate results than sensitizing with the etchant.

[16] "Stress Distribution Around an Elliptical Discontinuity in Any Two-Dimensional Uniform and Axial System of Combined Stress," by A. J. Durelli and W. M. Murray, Proceedings of the Society for Experimental Stress Analysis, vol. 1, 1943, p. 26.

[17] "Das Dehnungslinienverfahren," by O. Dietrich and E. Lehr, *Zeit. V.D.I.*, vol. 76, 1932, p. 973.

[18] "Residual Stress Indications in Brittle Lacquer," by C. W. Gadd, Proceedings, Society for Experimental Stress Analysis, vol. 4, p. 74.

AUTHOR'S CLOSURE

The operating mechanisms which cause brittle coatings to be useful stress-analysis tools are surprisingly complex. Already there are considerable data available involving such factors as loading cycles, creep, and atmospheric conditions during drying and testing. Yet much remains to be learned about many of the factors. The value of such detailed work on the tools themselves lies not only in the improvement of practical techniques but in furnishing a background which will enable the user better to understand what he is doing.

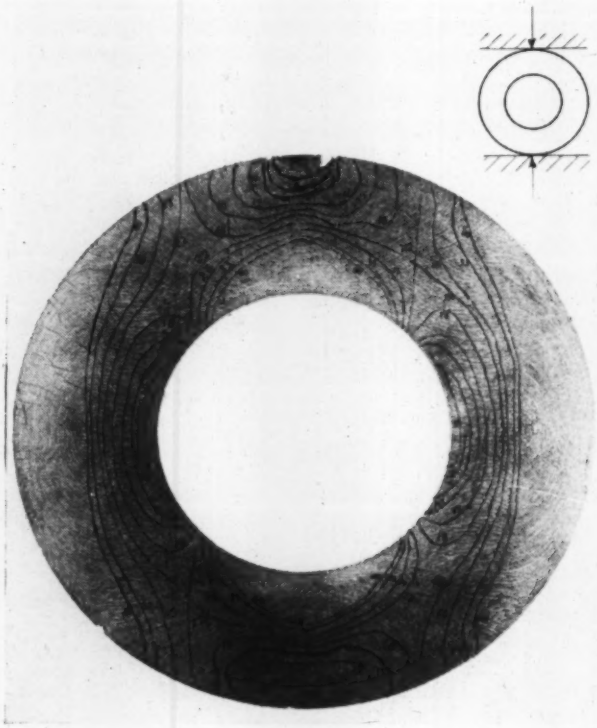


FIG. 1 RELAXATION LOAD PATTERN IN A RING, GIVING ISOENTATIC 2 AND THE COMPLETE SET OF ISOSTATICS 1

(Scale for 40,000 pounds: $\frac{0.03}{\text{Reading}}$.)

Dr. Durelli has made important contributions to the brittle-coating art in the past. His present comments show that he is active on some important phases. While the object of this paper is to show what can be done with Stresscoat as a stress-analysis tool rather than to enter into technical discussion concerning it, nevertheless the following comments are contributed on the points raised by Dr. Durelli:

Residual-stress measurement with Stresscoat needs more data as to the type and size of patterns developed under different conditions of biaxial stressing

of known amounts. Durelli suggests a photoelastic approach to the problem. While the photoelastic approach is interesting, it would seem better to set up known conditions and study them directly with Stresscoat. Gadd has already given a qualitative start on the problem in his paper[18] referred to by Durelli. Controlled quantitative data of the same nature are worth studying.

The variation of the amount of strain to start Stresscoat cracking under different conditions of biaxial loading was made the subject of a thesis by Olsen[19] in 1941. Olsen found that equal biaxial tension required about 25 per cent less tension strain to start cracking than did simple unidirectional tensile strain. For pure shear, where the biaxial stresses are tension and compression of equal amounts, Olsen required about 25 per cent more tension strain to initiate pattern formation. However, another investigation[20] concludes that Stresscoat is a true strain gage under torsion loading. Here is an obvious difference of opinion which can stand further clarification. A variable to watch is creep of the coating which can vary under different conditions of loading.

Olsen also checked simple compression loading with the same result as reported by Durelli that no patterns could be produced by the Poisson tensile strain developed on materials such as steel and bakelite which have a Poisson ratio of the order of 0.3 to 0.35. However, on soft rubber which has a Poisson ratio of 0.5, longitudinal patterns were produced by simple compression loading in the longitudinal direction. Apparently the effect is connected with the value of the Poisson ratio for the material which is coated with Stresscoat.

An interesting theoretical study could be made of the relation of Poisson ratio of the brittle coating to that of the coated material as affecting pattern formation. This whole field of biaxial stress reactions on Stresscoat is ready for more detailed study.

For the engineer who wants to build better machines, the technical considerations as to exactly how Stresscoat operates become secondary to finding ways of using techniques already proved operable. Much remains to be learned as to the best ways to tackle problems and get practical results with a minimum of effort.

GREER ELLIS.[21]

[18] Thesis on "Investigation of the Limits of Accuracy of Stresscoat," by C. E. Olsen, Jr., Massachusetts Institute of Technology, 1941.

[19] "Application of Brittle Lacquer Method in the Stress Analysis of Machine Parts," by by M. Hetényi and W. E. Young, Experimental Stress Analysis, Proceedings of the Society for Experimental Stress Analysis, vol. 1, no. 2, 1944, pp. 116–129.

[21] Consulting Engineer, Magnaflux Corporation, New York, N. Y.

Centrifugal Casting

COMMENT BY H. T. HARRISON[22]

In discussing this paper,[23] the writer will be primarily concerned with high-alloy tubes as his plant produces comparatively few carbon-steel tubes.

It is noted that the authors use a permeability of 115 with a moisture content of 6½ per cent, whereas we use a permeability of 100 to 105 and a moisture content of 3.2 per cent, consequently, we do not get as high a green compression strength. However, by the same token we reduce our drying time and maintain a green compression strength of 9.2.

In reference to orifice nozzles, the sizes referred to in this paper are, in the writer's opinion, as nearly correct as could be determined.

It is noted that the authors use a full-length pattern on all tubes, regardless of size, whereas on the larger-diameter tubes stub patterns have been used. The writer heartily agrees that the full-length pattern is much superior.

The method of drying molds, as outlined in this paper, is the proper procedure in the opinion of the writer, for this method more readily eliminates all moisture and produces a harder pouring surface than will be found on molds dried from the outside.

The writer differs slightly with the authors in the matter of speeds, as his experience leads to the belief that 105 times gravity for the larger tubes to 125 times gravity for the smaller tubes with wall thicknesses of ⅞ in. and under is a more satisfactory practice. On tubes with wall thicknesses over ⅞ in., a speed equivalent to 70 per cent of the foregoing speeds can be used.

The authors statement regarding the two-directional solidification on very heavy-wall tubes is quite true, but by control of the speed and time of spinning this can be greatly lessened, if not entirely eliminated.

In the matter of grain size on high-alloy tubes, in addition to wall thickness and pouring temperature, which the authors suggest, we would like to add speed and grain refiners as being governing factors.

The authors, in speaking of accuracy which can be maintained on the outside diameter of tubes with 4¾ in. OD, state that a tolerance of plus or minus 1/64 in. can be held. The writer would not care to guarantee this, for it is, in his opinion, impossible to control the shrinkage that closely.

The authors are to be commended for the very thorough and masterful way in which they have handled this subject, for anyone who has had any experience in the centrifugal casting of high-alloy tubes realizes the close control necessary of the many variables to produce satisfactory tubes.

COMMENT BY NATHAN JANCO[24]

Mechanical engineers quite often require heavy-walled tubing in a wide variety of sizes and alloys. If large quantities are not required, the pipe is unavailable except by utilizing the casting process. The only practical method of producing cast-steel tubing is by centrifugal casting, either in sand-lined molds, as described in this paper, or in metal molds.

The casting process is facile enough to permit small-quantity production of special sizes of tubing in particular analysis. The dependability of the castings, the physical properties obtained, and the stock allowances recommended in the paper provide valuable engineering data to the engineering profession.

Experimental steel-tubular castings were produced during the war which were used as raw material to be drawn into standard tubing. The application of centrifugal casting in the production of hollow billets for redrawing eliminates the pouring of the ingot, soaking, blooming, piercing, etc.

AUTHORS' CLOSURE

The authors are indebted to Mr. Harrison for a searching and informative commentary. Essentially, our practices differ very little. It may be well to clarify some of the variations.

The moisture content of our sand is governed primarily by the facilities for handling and drying. Sands with 3 to 4 per cent moisture have been tried but difficulty was experienced in drawing the 16-ft-length metal patterns, and considerable variation was noted in the outside diameter of cast tubes. Undoubtedly, as Mr. Harrison points out, a reduction

[22] Vice-President, The Duraloy Company, Scottdale, Pa.

[23] "Centrifugal Casting—Process Applied to Stainless and Carbon-Steel Tubes," by J. W. Moore and J. W. MacKay, MECHANICAL ENGINEERING, vol. 69, July, 1947, pp. 551–558.

[24] President, The Centrifugal Casting Machine Company, Tulsa, Okla. Mem. A.S.M.E.

in drying time will result when sands of low moisture content are used.

Mr. Harrison does not state whether he is referring to outside or inside diameter in setting up his gravity recommendations. This could be of paramount importance where g on outside diameter and inside diameter may be as much as 30 to 40 per cent apart.

For thin-wall tubes, Mr. Harrison's values of g are higher than we use. The only difference we have experienced is that higher speeds for thin tubes may result in metal penetration of the sand, but we have cast tubes of 1-in. wall and under up to 130 g on the outside diameter without experiencing cracks. For thick tubes, say, 3-in. wall and above, our experience has shown that it is dangerous to go above 100 g at the outside diameter.

We do not have much data on the effect of spinning speeds on grain size. This should be an interesting problem to explore. Our opinion is that we would find the effects of freezing rate overshadowing those of centrifugal force.

With reference to Mr. Harrison's comment on casting tolerance, it should be emphasized that the metal pattern for the 4 3/4-in-OD tubes was "tailor-made," but hundreds of tubes were produced to this tolerance. It is not difficult to make special patterns for small-diameter thin-wall tubes, which will result in as-cast outside diameter within plus or minus 0.03 in. of a selected nominal diameter. For ordinary production work, this tolerance should be doubled for diameters up to 12 in. and increased for larger diameters and heavier tubes.

J. W. MOORE.[25]
J. W. MACKAY.[26]

[25] Member, President's Staff, American Cast Iron Pipe Company, Birmingham, Ala. Mem. A.S.M.E.

[26] Sales Engineer, American Cast Iron Pipe Company.

Manufacturing Tubes by Extrusion

COMMENT BY W. A. DICKINSON[27]

This paper presents an excellent account of the development of high-temperature extrusion.[28] The data, regarding the extrusion of stainless steel, agree with those observed by the writer during work on various types of stainless. However, he has not found that holding stainless steel at the extrusion temperature for as long as 3 or 4 hr results in any operating or metallurgical difficulty. On the other hand, he has observed that overheating of stainless by 50 deg F above the temperature required for easy extrusion increases greatly its stiffness and abrasiveness to tools.

To the author's last statement regarding the advantages of extrusion, it should be added that elimination of surface defects has been one of the major benefits realized by the writer's company in making tubes by this method. Prior to the installation of the Huntington press, most of the tube shells were made for them by another company on a rotary piercing mill. Of the billets rolled, 15 per cent were scrapped outright and the remainder had to be ground on outside and inside diameters. The latter operation was extremely expensive, some tubes requiring as much as 8 hr of grinding. The adoption of the extrusion method has resulted in the elimination of nearly 100 per cent of the internal grinding on monel and nickel tubes and all but a light grind on inconel tube shells.

[27] Superintendent of Extrusion, The International Nickel Company, Inc., Huntington Works, Huntington, W. Va. Junior, A.S.M.E.

[28] "Extrusion Method of Manufacturing Tubes," by Hugo Lorant, MECHANICAL ENGINEERING, vol. 69, June, 1947, pp. 471–474.

COMMENT BY H. R. McLAREN[29]

The extrusion process is definitely needed in the seamless-steel-tubing industry for the purpose of producing tubes of materials required for the oil, chemical, and allied industries which cannot be fabricated by any other method.

There are several noticeable defects to the process as it now exists.

1 The process is too slow, owing to cooling of tooling and pump capacity of the units. It is understood that the pumps are only capable of making 30 extrusions per hr. Steam-cooling should be used on the tools to avoid waiting for them to air-cool.

2 The eccentricity on the first end out is too great and requires study to improve it. Tests show a variation of 5 to 40 per cent in eccentricity after cutting from 2 in. to 12 in. from the tubes.

3 Tooling requires further study. The writer suggests trying 0.25C 5 per cent Cr 1/2 per cent Mo for mandrels; also, the study of pure molybdenum for the dies.

If more presses came into use, it is believed that these problems would be solved.

Relative to speed of the extrusion ram, which is given as 4 to 6 ips, is this a controllable variable for one press, or is that the speed range built into various presses with a constant for any one press? Of what value is speed variation in a pressing process?

[29] Assistant General Superintendent, Timken Roller Bearing Company, Canton, Ohio.

COMMENT BY J. A. PERRY[30]

This paper describes a method of piercing round billets with a closing plate substituted for the die so that the displaced material extrudes backward around the piercing stem.

A similar piercing operation is used in the first step of the Wellman-Seaver push-bench method of making tubes. Experience in this process has shown that back extrusion of a round billet is irregular especially if the billet has been nonuniformly heated as is possible in a batch-type furnace. This results in deflection of the stem to one side and eccentric tubes.

Much better concentricity can be obtained by using a round-cornered square billet whose diagonals fit the diameter of the container. By selection of container and piercing-point size, it is possible to approach the condition where the cross-sectional area of the point equals the difference in area between the container bore and the billet section. Thus, piercing is a lateral displacement only and no back extrusion occurs.

Is it possible that where hot-rolled-billet surface can be tolerated, the lower cost of square billets compared to round might bring the economical extrusion of cheaper materials closer?

[30] Metallurgist, Canadian Bureau of Mines, Ottawa, Ont., Can.

COMMENT BY P. D. WHITE[31]

During the last few years considerable interest has been evinced by users of stainless-steel seamless tubing in material whose chemical compositions render them impossible or very difficult to process on a rotary piercing mill.

Various alloy compositions have been extruded since the start of this program. Some of the alloys, which our experience shows can be extruded are Type 304, Type 309, Type 316, Type 317, and Type 444-C.

Our experience to date has shown certain disadvantages in this process; these are as follows:

(*a*) Press loss of 15 to 25 per cent of metal due to plug and butt-end discard.

(*b*) There is room for much improvement in the reduction of eccentricity.

(*c*) A suitable extrusion lubricant must be developed for stainless steels. The common lubricants now in use, while having no effect on nickel, monel,

[31] Vice-president, The Babcock & Wilcox Tube Company, Beaver Falls, Pa.

etc., are highly carburizing to stainless steels.

(*d*) Tool life in extruding stainless is much shorter than that realized in extruding nickel, monel, etc. This is particularly true of the piercer nose, difficulty being experienced with breakdown and galling of the point material.

No doubt further experience in extruding difficult ferrous materials will answer these problems.

This process is coming into use at an opportune time when interest in many metals that are unpierceable by the ordinary rotary process is increasing, and as a contribution to the problem of making tubes of such materials the process is of great importance.

AUTHOR'S CLOSURE

As suggested by Mr. W. A. Dickinson, proper heating of the billets to exact and uniform temperature is very important for easy extrusion. It is agreed that overheating of stainless-steel material greatly increases its stiffness. If the author recalls correctly, the loss of plasticity occurred in stainless-steel material, containing tungsten as an alloying metal, when the maximum temperature was applied over a considerable length of time. This problem needs further investigation.

In answer to Mr. H. R. McLaren, the installation referred to in the paper was built for a limited production in nickel and nickel-alloy tubes. Extrusion presses for stainless steel can be equipped with pumps of large capacities in order to obtain the highest possible production. The latter, however, are limited by the time required for cooling and lubrication of the tools. Air-cooling of the high-alloy steels used for mandrels is admittedly slow and inefficient. Steam for cooling large-sized mandrels has been tried but was abandoned owing to warping of these pieces. Experiments are under way to oil-cool the mandrels and, for larger sizes, to apply continuous internal water-cooling. Apparently Mr. McLaren is comparing in his mind the rotary piercing method with the extrusion method. Along with the rate of production must be considered the initial costs and operating expenses. For example, it takes only five men to run an extrusion press as against 3 times that many for a piercing mill.

The concentricity of stainless-steel tubes can be kept within a tolerance of plus or minus $7\frac{1}{2}$ per cent in case the following conditions exist: (1) Proper proportion between billet diameter, billet length, and inside diameter of tube; (2) proper extrusion ratio; (3) uniform cooling and lubrication of the tools. The speed of extrusion mentioned with 4 to 6 ips applies to all those presses which are connected to an accumulator. The speed proper depends upon the resistance offered by the metal which varies during the extrusion stroke. Speed variation obtained through throttling of the pressure fluid has not been found to be of great importance when extruding stainless steel. Any press for this purpose should work at maximum possible speed, obtained through proper valving, and through limitation of the extrusion ratio.

Mr. J. A. Perry's comment is of interest and suggests some experiments which may be performed to improve the concentricity on stainless-steel tubes.

So far it has been found that the piercing of billets using large-diameter mandrels, with the die opening closed, as is being done with cylindrical billets in brass, copper, and high-nickel alloys, resulted in tubes of a better concentricity than those made by direct extrusion. This has to be attributed to a more complete and uniform filling of the container with metal, and to a more uniform friction between the metal and the container wall. Since extrusion billets for stainless steel must be free from scale and oxide, square billets are far more expensive to machine than round billets. To prevent back extrusion, only one size of mandrel can be used for one size of square billet. Another drawback with square billets is a chilling effect which takes place immediately where the rounded-off corners contact the container bore, thus resulting in four longitudinal heat checks on the tube. No matter whether round or square billets are being used, uniform temperature of them is required for a satisfactory concentricity of the tubes.

The amount of press scrap, referred to by Mr. P. D. White, is a function of billet diameter and piercing mandrel diameter. This scrap can be kept to about 12 per cent if it is not being attempted to produce from one given size of billet too many tube sizes which vary considerably in inside diameter and outside diameter.

At this time, the author cannot suggest a noncarburizing lubricant to replace the mixture of tallow and graphite now in use. Good success in eliminating some carburization on the outside surface was obtained by blowing compressed air onto the tube emerging from the press as a means of oxidizing the gases responsible for this carburization. This problem has not been brought to the author's attention before in connection with existing installations which have been extruding stainless-steel tubes for many years, so it seems that carburization takes place on particular types of stainless-steel alloys, which only recently have come into use.

Tool life is definitely much lower on the high-molybdenum stainless steels but steady improvement has been made in this regard. It is realized, however, that real progress will occur only through larger volume production and co-operation within the steel industry.

As a general comment, it may be stated that rotary piercing and extrusion are not so much competitive processes as supplementary ones. On materials which lend themselves to piercing, the economic aspects of the case rule out extrusion, should the quality of the tubes be satisfactory, but on the other hand, extrusion can produce tubing which cannot be made by any other means.

H. LORANT.[32]

[32] Vice-President and Chief Engineer, Hydropress, Inc., New York, N. Y.

Fire-Control Equipment

COMMENT BY IRA JACOBSON[33]

Will the author[34] please state whether power saws and other portable power tools are being used extensively in fire-control work?[34] An important phase of fire fighting is felling trees and snags in the fire-break area. Heretofore the hand saw and axe have been used, but the development of power chain saws for logging and carriage-mounted power circular saws for pulpwood and land clearing suggests their use for fire fighting.

Therefore, a logical project for the development centers would be the design and improvement of power tools of this type so that they will have the dependability, efficiency, and portability necessary for fire-control work.

COMMENT BY GIL. STEWART[35]

The primary purpose of this paper is to bring about better co-ordination between the men with the "know-how" in the equipment industry and the men who use equipment in controlling forest fires. Many changes and improvements have

[33] Quirk Company, Cudahy, Wis.

[34] "A Development Center for Forest-Fire-Control Equipment," by I. C. Funk, MECHANICAL ENGINEERING, vol. 69, 1947, pp. 544–547.

[35] Fire-Control Development Center, Roscommon, Mich.

been made, but as yet there has not been enough progress. Forest fires are far different from city fires, and city fire-department equipment is not suitable at all for forest work.

A forest-fire-control organization is like a company of infantry in the Army; it uses a tremendous variety of equipment. The forest-fire boss must analyze continually the ground and the situation, and assign more men and equipment at the right time to the right place. Skilled operators must be available to operate all needed equipment. Above all, it must be realized that man still depends greatly upon the advent of favorable weather conditions to permit him to control a bad forest fire.

In the past, the men in the forest-protective organization were not trained as engineers. Nor were the industrial engineers familiar with conditions encountered in forest-fire control. As a result, field men made over standard equipment and came out with "Rube Goldbergs;" centers of gravity were too high, load distributions were bad, speeds and power ratios were wrong. The committee set up by this Society is in an excellent position to bring the industrial engineers and field men together. The five development centers which have been set up give excellent bases for action. The establishment of these centers dovetails very nicely with the work of the committee.

AUTHOR'S CLOSURE

A large number of power tools, such as gasoline-engine-driven chain saws, are used in forest-fire control. Although present power saws are suitable, further development, especially reduction in weight, is desired. The Forest Service is rapidly changing to airplane and helicopter transportation of men and equipment. This means that greater emphasis is to be placed on lighter-weight power-driven equipment.

IRA C. FUNK.[36]

[36] Senior Mechanical Engineer, Arcadia Fire Control Equipment Development Center, United States Forest Service, Arcadia, Calif.

Ammonium Nitrate Explosions at Texas City

TO THE EDITOR:

The purpose of this communication is to offer reasons for the explosions of ammonium nitrate at Texas City or as an aid in the solution of the problem of providing safe handling of that material.

Just as ordinary combustible fuels are not dangerously explosive under routine handling conditions when they completely fill a container, but are definitely so in a partially filled one, ammonium nitrate is also explosive under certain conditions. As a matter of fact ammonium nitrate is used in some explosives (dynamite), and only enough nitroglycerin is added to give the desired sensitiveness.

Explosions are caused by detonation, pressure, or heating.

The problem at hand is to determine the cause of the Texas City explosions. The steamship *Grand Camp* was at her berth ready to complete loading ammonium nitrate immediately prior to the explosion. This removes the possibility that shock detonated the cargo.

The pressure of the bags of ammonium nitrate piled one on top of another was not great enough to cause explosion to result from pressure above. If a pile of ammonium nitrate were 30 ft high in the ship's hold, the pressure at the bottom of the pile would amount to 108 lb times 30 ft divided by 144, which equals $22\frac{1}{2}$ psig.

Consider now the possibility that heat caused the decomposition of the cargo. When the bags of ammonium nitrate are loaded into the hold of a ship, there are air spaces in and between the bags. Air in the ship's hold may be about 120 F. In the case of the *Grand Camp*, the bags could have settled, and it is reasonable to assume that they did so. This reduced the volume of the air between and in the bags. This compression would raise the pressure and temperature, but air pressure outside the bags could not exceed that due to its own weight on the bottom as air would leak out between the bags. But what about the air trapped in the bags?

The bags are made of five plies of paper (waterproofed) and can withstand considerable pressure from within, exerted by air trapped so that it cannot escape through the filling end, as would be the case with the ammonium nitrate packed so as to block it.

Ordinarily we do not think of paper as very strong but it has an ultimate tensile strength from 500 to 2500 psi. A small thin-walled pipe can carry a relatively high pressure whereas a 12-in. pipe of the same wall thickness can carry only a comparatively small pressure. In the same way a small corner of a bag could carry a fairly high pressure before bursting.

When air is compressed from 14.7 to 37.2 psia ($22\frac{1}{2}$ psig), the temperature rises from 120 F to 297 F, based upon adiabatic compression, which is probable because the bags surrounding those where action is taking place provide insulation.

From information at hand, ammonium nitrate, when subjected to heat at approximately 220 F, decomposes, and the first result is the formation of ammonia and nitric acid. Between 220 F to 390 F, the reaction is endothermic. At approximately 390 F the reaction becomes exothermic, resulting in the formation of nitrogen monoxide and steam. Further rise in temperature by rapid action would produce nitrogen, oxygen, and water, which usually accompany explosive decompositions. Explosion can also result at only 240 F when heating is of long duration and in the presence of organic material.

The temperature of 297 F found possible by adiabatic compression of the air would not be reached unless heat were supplied from an outside source, as endothermic reaction of the ammonium nitrate would set in at about 220 F. However, the compressed air outside the bags would help to compensate for the endothermic reaction inside the bag. Also, when it is considered that nitric acid is a strong oxidizing agent, that the bags are of paper, and that the ammonium-nitrate particles were probably covered with organic matter to prevent hygroscopic action, serious possibilities are encountered.

The five plies of the paper bag are arranged as follows: Two layers of paper next to the ammonium nitrate, then a layer of asphalt-treated paper for waterproofing, and finally, two more layers of paper.

It is possible that, at approximately 220 F, oxidation of the paper and organic covering of the particles by the nitric acid would furnish heat for a local temperature rise to 390 F where the reaction becomes exothermic, furnishing nitrogen monoxide, steam, and its own heat, and a rapid temperature rise would cause local decomposition until the whole mass exploded.

The asphalt-treated paper is resistant to acid and hence would help retard oxidation of the two outer layers of paper until the pressure of the gases from decomposition of the ammonium nitrate broke them and the asphalt-treated one as well.

Nitric acid reacts with paper to form explosive nitrates, variously known as

nitrocellulose, pyroxylin, and guncotton, because paper has a cellulose base. Short-time action would give soluble nitrocellulose, while more concentrated acid for a longer time would result in guncotton. Commercially, guncotton is well washed to remove all traces of acid which might cause spontaneous explosion. It is possible that the Texas City case may fall in this class, namely, a reaction to guncotton but without washing. Small spontaneous explosions at 240 F could furnish the heat rapidly and locally—small volume affected—to change the reaction from an endothermic to an exothermic one, and from then on the ammonium-nitrate reaction would furnish its own heat, affecting larger and larger volumes of the cargo until finally the entire mass would explode. To accomplish this, it should be borne in mind that to have a high stack of bags in a confined space will permit rapid burning in a small portion of the entire mass.

An observer of the *Highflyer* explosion states that fire came in bursts from the hold for 10 min before the explosion of her cargo of ammonium nitrate occurred. During this 10-min period the ammonium nitrate was fast approaching a condition of burning in a confined space. It may be that the waterproofing layer of the bags helped the decomposition of the ammonium nitrate at high temperatures. The explosion of the *Grand Camp* certainly jarred the cargo of ammonium nitrate in the *Highflyer* enough to cause the bags to settle, compress the air, raise the temperature, start decomposition, and finally explode the ammonium nitrate. Accordingly, the *Grand Camp* and the *Highflyer* fall in the same category.

It would seem that a possible way of preventing such an explosion would be to pile the bags of ammonium nitrate in layers not over 5 ft high (providing a factor of safety). Then a self-supporting steel structure could be placed and another layer added, and so on. This would prevent the air between the bags from being heated excessively and would prevent excessive air pressure being built up in the sacks. A 5-ft layer of bags of ammonium nitrate would not cause over 3.25 psi, due to its own weight. This rise in pressure would cause a temperature rise of 35 F which would give a final temperature of 155 F. This temperature is well below the dangerous one of 220 so would satisfy safety requirements.

J. E. JACOBSON.[37]

[37] Texas City, Texas.

Aircraft Starter Systems

COMMENT BY D. E. CARR[38]

The author has done a creditable job in outlining the problems and difficulties of starting "turbojet" and "propjet" units and in describing possible starting systems.[39] The horsepower, per cent cranking speed, and time of starting differ so greatly from reciprocating engines that the problems are not even similar and must be treated accordingly.

In regard to electrical ground-powered starting systems; the author has disregarded this type because of weight. True, electric motors are relatively heavy and unless radical design changes are made, will hardly be applicable to the large-horsepower aircraft gas turbines of the future. However, with the starting-horsepower requirements for turbojets and propjets now in existence, electrical ground-powered systems seem to have attractive possibilities.

A direct-current electric motor rated 40 hp and weighing 82 lb has been completed and bench-tested. This motor is powered from an external source which provides a high current of 400 amp for the initial part of the cycle, and then allows the voltage to rise to a no-load potential of 170 v. The circuits are arranged to regulate voltage and current for approximately constant kilowatt or horsepower starting.

This system with wiring and connectors has an installed weight of approximately 2.25 lb per hp and is indeed large if the total weight is charged to the starting system. The motor is mechanically connected to the gas turbine by means of a free-wheeling clutch and, as soon as the gas turbine is running at greater than cranking speed, the clutch disengages the motor. By means of an additional free-wheeling clutch and gear train (approximate weight 20 lb), this motor may also be used as a generator for either 28- or 120-v systems. The motor is capable of a 30-kw output continuously. However, if it is used only to replace a 28-v 300-amp or 8.5-kw generator, the weight saving is 45 lb. On this basis, the total weight of the starter including motor, connectors and wiring is only 67 lb or 1.65 lb per hp.

A propjet unit has a high inertia to friction ratio, therefore, the unit coasts for several minutes after shutdown. When unloading passengers from transports, this delay is a distinct disadvantage. Aerodynamic forces on the unit and propeller reduce the speed to a low value very quickly and then lose their effect. The large starting motor, when electrically connected to a low-value resistance, makes an ideal brake. The final stop can be accomplished by reversing the battery polarity to the motor and plugging to standstill.

In addition to these two functional advantages, electrical systems in general are (1) very flexible, (2) easy to control, (3) easy to connect and disconnect, (4) relatively free of maintenance.

A. K. FORNEY.[40] The author has certainly made clear that the starting problem for turbojet and gas-turbine engines is a difficult one. At this stage of development one cannot go much further than this because of the large number of unsolved problems connected with starting these engines, particularly when applied to military and naval aircraft. He leaves the impression, however, that the use of ground-powered starting systems is likely to be the answer for turboprop and turbojet engines. Such is not the case for carrier-based aircraft, seaplanes, and flying boats because of the limited space available for the use of ground equipment which will probably be bulky and cumbersome.

There is one design feature of gas turbines which has recently been used in Great Britain and is being considered for use by manufacturers in the United States, that will so reduce the starting power required that it is worthy of mention. This feature is the use of two independent turbine wheels in the same engine. One turbine wheel is used to drive the compressor and accessories; the other is used to drive the propeller. In such an engine the starter is not required to turn the propeller and reduction gearing. Consequently, the starting power required is reduced to a point comparable to that of turbojet engines.

[38] General Engineering and Consulting Laboratory, Aeronautical Development Section, General Electric Company, Schenectady, N. Y.

[39] "Aircraft Turbojet and Gas-Turbine Starter Systems," by A. G. Bardwell, Jr., MECHANICAL ENGINEERING, vol. 69, July, 1947, pp. 577–590.

Correction to "Trends in Solid-Fuel Research"

ON page 826 of the October, 1947, issue of MECHANICAL ENGINEERING, in the article "Trends in Solid-Fuel Research," by H. J. Rose, read as follows: "Present estimates place our total domestic gasoline demand at *0.860 billion* barrels in 1950. . ." And eleven lines below, "All of these German plants combined, produced only 29 *million* barrels a year at the peak rate of wartime production."

[40] Power Plant Division, Bureau of Aeronautics, Navy Department, Washington, D. C.

A.S.M.E. BOILER CODE

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code may communicate with the Committee Secretary, A.S.M.E., 29 West 39th St., New York 18, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting.

This interpretation is later submitted to the Council of The American Society of Mechanical Engineers for approval after which it is issued to the inquirer and published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of Sept. 12, 1947, and approved by the Council on Oct. 16, 1947.

CASE NO. 1041 (REOPENED)

(Special Ruling)

Inquiry: Is it permissible under the Code to employ cast steel of the composition and physical properties given below for high-temperature valves for service at 1000 F:

Carbon, per cent	0.20–0.30
Manganese, per cent	0.45–0.65
Silicon, per cent	0.25–0.55
Phosphorus, max, per cent	0.045
Sulphur, max, per cent	0.05
Chromium, per cent	0.40–0.70
Nickel, per cent	0.75–1.05
Molybdenum, per cent	0.85–1.05
Tensile strength, min, psi	85,000
Yield point, min, psi	60,000
Elongation, min, per cent	20
Reduction in area, min, per cent	40

Reply: It is the opinion of the Committee that the steel specified above may be used for the purpose stated provided that in other respects it meets the requirements of Specification SA-217, Grade WC4, except that the drawing temperature be 1300 to 1325 F. Also, if any welding is to be done on these valves, the welding procedure and welding operator shall be qualified under the rules of Section IX of the Code. The permissible stresses for this material shall be as follows:

For metal temperatures not exceeding deg F			
—20 to 650	700	750	800
15000	15000	15000	14000
850	900	950	1000
12500	10200	8250	6250

CASE NO. 1050

(Interpretation of Par. P-186)

Inquiry: Par. P-186(e) provides welding details and Par. P-186(f) gives a formula for calculating the maximum loads to be supported by structural steel attachments to tubes. In lieu of that method of determining maximum loads on attachments, will it meet the intent of the Code if a test conducted on a full-size section of tube with its attachment, and subjected to design hydrostatic pressure as well as a load proposed for design shows safe construction?

Reply: It is the opinion of the Committee that the requirements of the Code will be met provided:

(1) The loading applied to the test specimen is at least equivalent to the design loading, and at the same time the tube is subjected to a hydrostatic pressure corresponding to design conditions;

(2) The test is conducted in accordance with the requirements of Pars. A-22 to A-32 with the exception that the hydrostatic pressure be held at expected design pressure, and the loading on the support be increased until permanent set occurs;

(3) The maximum design stress on the basis of such test corresponds to that permitted for the tube material at the expected operating temperature in Table P-7, but not less than 750 F.

CASE NO. 1054

(Interpretation of Par. U-208)

Inquiry: When vessels having main seams of identical design are in continuous production under controlled repetitive procedures and are constructed in accordance with the requirements of Par. U-201, is it permissible to make a destructive test on vessels selected at random in lieu of the spot examination of each vessel as specified in Par. U-208?

Reply: It is the opinion of the Committee that in constructing vessels under the provisions of Par. U-201, having main seams of identical design under controlled repetitive procedures, and on a production line basis, that the purposes of Par. U-208 will be accomplished and the intent of the Code will be met for vessels having a shell thickness not exceeding $\frac{5}{8}$ in., and having a capacity of not more than 100 cu ft, if completed vessels are selected from each production line and submitted to the following procedure:

(1) The authorized inspector shall select one vessel of every 100 vessels as made on each production line in use (not less than one vessel from smaller lots or remainders) on each shift. These vessels may be selected before or after the normal hydrostatic tests prescribed under Par. U-77 for all vessels.

(2) The manufacturer shall test all vessels so selected which shall withstand a hydrostatic pressure of 4 times the design pressure, by slowly increasing the pressure above twice the working pressure until the required maximum test pressure is reached.

(3) Either before or after this latter test, each selected vessel shall be subjected to and shall meet the requirements of the spot examinations called for in Par. U-208. Vessels tested in the above manner shall be scrapped.

(4) If, when under hydrostatic test, a selected vessel shows leakage at less than the normal hydrostatic test pressure, it may be repaired by approved methods and subsequently subjected to the further hydrostatic pressure testing. If leakage occurs after the hydrostatic test pressure has exceeded the normal test pressure and before the test pressure has reached 4 times the designed pressure, two additional vessels from that same lot, to be selected by the authorized inspector, shall be subjected to a similar test. If failure occurs in either vessel, the entire lot may be rejected, or after the failure of any one of the three vessels, each vessel of the same lot may be subjected for acceptance to the requirements of Par. U-208 for spot examination.

CASE NO. 1056

(In the hands of the Committee)

CASE NO. 1057

(Interpretation of Par. P-199)

Inquiry: Par. P-199(c) provides only for riveted doubling plates. Is it permissible to attach doubling plates to flat stayed surfaces by the use of fillet welds around the periphery of the doubling plate?

Reply: Although Par. P-199(c) does not provide for welded construction, it is the opinion of the Committee that a doubling plate so attached will meet with the intent of the Code, provided:

(1) The doubling plate is securely attached at its edges by intermittent or continuous fillet welds;

(2) The inner and outer plates are held together with stays in accordance with the rules for stayed surfaces; and

(3) The welding is stress-relieved.

CASE No. 1058

(Interpretation of Par. P-199)

Inquiry: When welded stays and welded doubling plates are used, does the maximum pitch limitation in Par. P-204 apply?

Reply: It is the opinion of the Committee that when welded stays and welded doubling plates are so used to reinforce flat surfaces required to be stayed, Par. P-199 shall apply without the $8\frac{1}{2}$ in. pitch limitation and the value of C is 150.

CASE No. 1059

(Interpretation of Par. P-311)

Inquiry: Are two blowdown valves required on coil type forced-circulation boilers as generally provided in Par. P-311 of the Code?

Reply: It is the opinion of the Committee that in this type of boiler having a normal water content not exceeding 100 gal, the requirements for two valves in Par. P-311 are not applicable. Under the exception in the fifth paragraph of the Preamble and if otherwise in accordance with Code requirements, the use of one slow-opening blowoff valve will meet the intent of the Code.

CASE No. 1060

(In the hands of the Committee)

ERRATA

In the 1947 Addenda to the Power Boiler Code, the third sentence of Par. P-296, as it appears in the Code, was inadvertently omitted. This sentence reads as follows: "For boilers carrying 500 lb pressure or over, valves may be used in place of cocks."

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Human Factors in Management

HUMAN FACTORS IN MANAGEMENT. Edited by Schuyler Dean Hoslett. Harper & Brothers, New York, N. Y., 1946. Cloth, $5\frac{1}{2} \times 8\frac{1}{2}$ in., 322 pp., $3.50.

REVIEWED BY JACK WOLFF[1]

THIS book by a score of writers is being reviewed here for the executive or supervisor in industry because of its helpfulness toward the profitable operation of a business enterprise.

It is refreshing to find that some of these writers, including college professors, tell their stories in grammar-school English. Their skill in the use of simple language adds greatly to their forcefulness; and it carries conviction. They have increased their helpfulness to the businessman because they have eliminated the psychopersonnel jargon and the four-bit word. May an increasing number of business and industrial writers follow with them in the footsteps of Abraham Lincoln whose speeches and writings have become immortal because they express human thoughts in simple words.

This work is divided into three main parts: Part 1, the executive and the organization, deals with the nature and conditions of leadership and training leaders in human relations. Part 2, the worker and the organization, covers studies in human relations and the facilitating of adjustments through counseling methods. Part 3, critiques, the introduction of psychologists, anthropologists, and sociologists into industry as an essential part, or even a supervising part, of the industrial-relations organizations. At several labored points in this latter part, I nearly said, "Heaven forbid!"

The man or woman in industry who buys this book need not worry if he finds some parts of little interest or value. The reader will be well repaid for his investment in time and money by studying particularly the significant contributions of George C. Homans, Fritz Roethlisberger, Douglas McGregor, and Ordway Tead.

Because so many authors write on overlapping subjects, there are some duplications in making points or quoting other authorities. But certain significant facts bear repetition because they have been overlooked too long—if the present wave of labor trouble is an indication that executives and supervisors have overlooked many human factors in dealing with their subordinates.

Ordway Tead of Harper & Sons starts off by writing of the development of leadership power. He says "some people have power because they have discovered some of the tricks of influencing others. Next, some people have power because they take it. Others have power because they are in a position where it can be exercised as a responsibility inherent in their position within the organization. Finally, people find themselves to have, and are acknowledged by others to be possessed of a capacity for influence and persuasion which is powerful." After analyzing these he decides, "At bottom we influence people because it becomes known that we are concerned for their welfare. The leader is the man who knows that common action comes from common intention and he peculiarly helps to supply the common intention." A football team has a "common intention." That's why the players exert "common action" in trying to get the ball across the enemy goal line. Tead points out that the problem confronting each business is for each executive and foreman to learn and believe that he will accomplish far more for himself and his company by applying the proved principles of leadership to his own job. Only so can he secure the eager and intelligent support and participation of his people in reaching a common goal. It should be said at this point, however, that in every large company the executives or foremen who are the worst offenders in antagonizing their subordinates and thereby hurting production are the very persons who are perfectly sure that they know exactly how to "handle men." Because they are so sure of their own perfection, they make no attempt to analyze their faults and weaknesses so as to overcome them.

Chester I. Barnard, president of The New Jersey Bell Telephone Company,

[1] Jack Wolff and Associates, New York, N. Y.; Special Representative, Office of Assistant to the President—Personnel, Chesapeake & Ohio Ry., Cleveland, O.

develops the thought-provoking idea that engineering schools in giving leadership training should stress the laws of human reactions as adequately as they stress the laws of leverage in an engineering course. He also tells executives to help their engineering men to develop a knowledge of and an appreciation for the effective use of psychological laws.

Douglas McGregor of M.I.T. takes another slant at leadership in an industrial organization. He stresses the dependence of the subordinate on the superior for the satisfactions he needs on the job. He shows how the overbearing supervisor stifles the initiative of his employees who are afraid to stick out their necks for fear of displeasing the foreman—even though they could have helped to prevent heavy losses to the company by doing so. He indicates that supervisors themselves often feel insecure and cannot develop their leadership until their own superiors help them to develop self-confidence by delegating more responsibility to them—such as securing their participation in working out plans.

Fritz Roethlisberger of Harvard really goes into this last phase in the reprint of his widely read "The Foreman: Master and Victim of Double Talk." He develops a stark picture of the breakdown point in the chain of organized effort toward a common goal. He states emphatically, and is supported fully by many successful industrial leaders, that if management is to secure the wholehearted and intelligent co-operation of employees it must bring the foreman actually into management in the development of plans, procedures, and accomplishments. He warns, however, that management will not do this so long as it considers this a social problem. He says management will devote that necessary "one half of one per cent of the time, effort and money" only when top executives have convinced themselves that their own well being and that of their company depends upon this new approach. Even though the reader has gone through this paper before, it is not "old stuff." It will be new and valid in 1950. And any executive who hasn't time to read a lot of stuff because he is working night and day to keep his plant going properly is just the man who needs to take off some time to study this chapter.

Goldsen and Low present a case study of "personal immaturity" that concerns two executives. Even though it contains some valuable material, I'm afraid that "our scientists in the social laboratories" will not "exert influence" in the "working world" until they present their stories in the working-world language. I question whether the executive with "destructive ego-involvement" will recognize that this accusing finger points at his own "traumatic nature." Fortunately only a few articles in this volume have been written at this too-too professional level.

George Homans of Harvard has presented what to me is the most important single analysis and the most definitely helpful point of the entire volume. He has put it into plain English. His case stories are simply told, and yet so vividly, that any executive or foreman who has been alert in his supervision and guidance of human beings will testify to their truthfulness. Homans has done even more for the executive or foreman who wants to increase his own skill in obtaining the enthusiastic and intelligent participation and help of his subordinates. He points out how the groups of employees can be stimulated to use their always existing, but frequently submerged, group teamwork and group leadership for the mutual welfare of the company and themselves. On the other hand, he shows how the employees can be and are egged on by management itself through management's own faulty leadership to checkmate the executives' and supervisors' efforts to improve production for their mutual advantage.

The executive or supervisor who is anxious to increase the effectiveness of his own leadership and the employer-employee relations in his company should study and restudy Homans' story. He should then proceed to practice again and again the use of these simple commonsense principles so as to secure the wholehearted and intelligent teamwork of his own workers.

If one has not read "Management and the Worker," by Fritz Roethlisberger and W. J. Dickson (Harvard University Press, 1939), this story will be new and forceful and bring to him the meat and the understanding of that entire volume. If one has studied the book, this article will bring added meaning and significance to that justly famous experiment at the Western Electric's Hawthorne plant which first focused the eyes of industrial leaders and researchers on the importance of human factors in management.

This one article alone is worth far more than the price of the book to that employee, supervisor, or executive who wants to become highly skilled and effective as a leader of men in an industrial company.

German Research in World War II

GERMAN RESEARCH IN WORLD WAR II. By Leslie E. Simon. John Wiley & Sons, Inc., New York, N. Y., 1947. Cloth, 5⅞ × 9 in., 211 pp., 72 figs., $4.

REVIEWED BY M. J. ZUCROW[2]

COL. L. E. SIMON'S book should be of interest to all persons engaged in the different phases of research. It should be of particular interest to those charged with administering research programs in the interest of national defense. In a book of 211 pages, Colonel Simon presents a critical analysis of the causes underlying the successes and failures of German research conducted during the years ending World War II. The author undertook the difficult task of re-creating the different German research agencies from bits of information obtained from many sources.

Considering the chaotic conditions existing when this information was being assembled, the author is to be congratulated for preparing so logical an analysis. Undoubtedly some readers will object to certain details of the research-organization charts prepared by the author. The broad background outlined by these charts, however, is the important thing.

The author's main interest was in weapons. He has consequently presented short descriptions and criticisms of the German research activities in that field. The treatment is not exhaustive but more can hardly be expected in a small volume. Detailed information concerning specific problems studied by the Germans is not presented because the prime object of the book is to analyze and criticize the manner in which the Germans were organized to conduct research.

The study presented by the author should be a valuable guide to those planning research as a part of the National Defense Program. He points out: (1) The evils of excessive security as practiced by the Germans; (2) the relationship between suitable living conditions, wage standards, and successful scientific endeavor; (3) the great necessity of freeing those engaged in scientific pursuits from a superfluity of red tape and unwarranted interference by unskilled military officials; (4) the importance of providing a mechanism for

[2] Professor of Gas Turbines and Jet Propulsion, Purdue University, Lafayette, Ind. Mem. A.S.M.E.

the free interchange of scientific ideas among those engaged in the solution of similar problems. His analysis indicates that many of the failures of Germany were due to the top officials who disregarded these principles.

In chapter 2 the author discusses some of the factors of fundamental importance to research activities. He subdivides all research endeavor into the following basic classes: Basic research, technical research, design, and development. It is by a proper correlation of these four different research functions that an idea can be converted into its practical application. The Germans in their organization for research, failed to give due recognition to the importance of the development function. They did not dignify it to the extent that they did basic research so as a result many of their programs failed to attain a practical realization of their main objectives.

In chapter 5 the author presents the organization charts of the different agencies. His study reveals that there was a serious lack of co-ordination. Furthermore the Speer Ministry, an agency charged by Hitler with general supervision of production of war material, with its broad powers retarded scientific progress by its interference, except in the research organizations of the Air Forces. The latter were only able to escape interference from the Speer Ministry because one man Baumker who was a personal friend of Goering could prevent interference. The author concludes that German research showed three basic defects: (1) Poor planning for future requirements; (2) failure to provide an adequate development organization; (3) lack of intelligent communication between research and military. Its successes were due mainly to the "shot-gun" effect of conducting a large amount of research so that some had to be successful.

The descriptions of German ballistics establishments and their research presented in chapter 7, indicates that the Germans were well equipped to carry on effective research in the ballistics field. But on the whole the work was not outstanding. There was a lack of co-ordination, no well-organized development groups, and basic design data that were accumulated were not put to effective use because there was no adequate liaison between science and the armed forces.

Chapter 9 presents a summary of the more important aerodynamics establishments and their research contributions. The wind tunnels at LFA, (Luftfahrtforschungsanstalt), Kochel, and Otzal are described, and the measuring techniques employed. German instruments are described and analyzed in chapter 10. The treatment is quite brief but adequate for the general reader.

The more important development work conducted by the Germans is discussed in chapter 11. The emphasis is largely on weapons and armament. On the whole there was a tendency in many quarters to produce the spectacular rather than the useful. The development, again, was not conducted by an impartial organization organized for carrying out that function. As in the case of weapons, the research program was left to some industrial organization which had a special interest in the outcome. In other cases the development was conducted by organizations having no interest in that type of activity.

One is led to the conclusion that placing development entirely within the hands of industry without adequate scientific organization to control the contract is poor policy.

Chapter 13 should be studied with care by those directing research for the armed services. The author suggests organizations and procedures for developing new devices. Although the remarks are directed in the main to weapons, they apply to research in general.

In closing, the reviewer points out that Colonel Simon's book is interesting and worth-while reading.

Time and Motion Study

A MANUAL OF TIME AND MOTION STUDY. By John W. Hendry, Pitman Publishing Corp., New York, N. Y., 1946. Cloth, $5^3/_8 \times 8^1/_2$ in., 215 pp., 49 figs., $3.

REVIEWED BY J. W. DEEGAN[3]

MR. HENDRY has aptly stated the scope of his book in the foreword when he discusses the need for "a practical application of the principles rather than treatment covering every detail of time and motion study."

The author exhibits a working knowledge of the management support required, the need for comprehensive and specialized training for time-study personnel, and other requisites of a sound time and motion-study program. He particularly stresses the universality of the application of wage incentives and the need for standardization of time values.

The reader will find little information in this book that is not already published in the standard textbooks. He will, nevertheless, be interested in the discussion of relaxation time and fatigue allowances, and the references made to the human-relations side of the job. Interesting also is the "English" terminology used. For example an incentive plan becomes an incentive scheme, and service functions become ancillary functions.

Practicing time-study men will likely take issue with some of his observations. For example, he states that a plastic molder is given a higher fatigue allowance than his helper even though the helper's work "is undoubtedly more exhausting." He reasons that the molder is entitled to extra fatigue allowance because of the knowledge required to operate the press. Most analysts would consider the knowledge required to perform the job in establishing the base rate for the job. Likewise, he asserts that the tendency on the part of the time-study observer is to overrate excellent performance. This is not consistent with the fact that qualified engineers find it necessary in their ratings to compensate for a natural tendency to underrate skilled performance and to overrate poor performance.

[3] Glass and Closure Division Industrial Engineer, Armstrong Cork Company, Lancaster, Pa.

Steel Castings

STEEL CASTINGS. By Eric N. Simons. Chemical Publishing Co., Inc., New York, N. Y., 1947. Cloth, $4^3/_4 \times 7^1/_8$ in., 208 pp., 52 figs., $5.

REVIEWED BY JOHN H. ROMANN[4]

A widely distributed mass of information on steel castings has been assembled by the author into a small and handy book form. The subject is treated complete in fifteen chapters from the raw materials to the finished steel castings. Each step in the process of manufacture is clearly defined, complete in its description and yet not too technical for the layman. It is the ideal textbook for students and a ready reference for the technical staffs of engineering offices, purchasing departments, and foundry personnel.

The most outstanding and clearly written chapters are the ones dealing with the *steels* for castings. The treatment of the subject matter in the various groups is so strikingly simple yet so

[4] Vice-President and Consulting Engineer, U. S. Engineering and Manufacturing Company, Chicago, Ill. Mem. A.S.M.E.

complete that the information is readily absorbed and remembered.

The subjects treated in this book are: (1) raw materials; (2) melting processes; (3) patterns; (4) foundry sands; (5) molds and cores; (6) centrifugal casting of steel; (7) cleaning of castings; (8) heat-treatment; (9) machining; (10) inspection and testing; (11) steels for castings (three chapters); (12) buying steel castings; (13) interesting steel-casting samples.

Powder Metallurgy

POWDER METALLURGY. By H. H. Hausner. Chemical Publishing Co., Inc., Brooklyn, N. Y., 1947. Cloth, $5^1/_2 \times 8^1/_2$ in., 307 pp., 66 figs., bibliography, $7.

REVIEWED BY PETER E. KYLE[5]

THIS recent work in the field of heat-treated compressed-metal powders is divided into three parts. Part 1 deals with general data on powder metallurgy and includes (*a*) the glossary of terms compiled by the A. S. M. Committee on Powder Metallurgy, (*b*) a chapter on the principles of powder metallurgy, (*c*) a discussion of the manufacture of metal powders and the applications of the commercially available powders, and (*d*) a compilation of data showing a comparison of sintered and fused metals.

Part 2 is made up of many graphs and tables showing the effects of the variables in the process such as composition, particle size, pressure, sintering temperature and time, atmospheres during sintering, and subsequent working.

Part 3, which occupies 130 pages, is a chronological bibliography on powder metallurgy from 1800 to 1945 including a subject and author index.

In general the book treats many of the subjects so briefly that the beginner will find it impossible to learn how powders are manufactured, what equipment and procedures are used in pressing and sintering, and the type of product commonly made by the process.

In some cases the summary tables and graphs showing the effects of variables on physical properties are sufficiently complete to be of value to the research worker, but in general, it will be necessary to refer to the original work for detailed information.

The greatest value will undoubtedly be derived from this book by those who have use for the 1064 references given in Part 3 and some of the data abstracted from these references in Part 2.

[5] Professor of Metallurgy and Assistant Director of the School of Chemical and Metallurgical Engineering, Cornell University, Ithaca, N. Y. Mem. A.S.M.E.

Books Received in Library

AMERICA'S NEEDS AND RESOURCES, A Twentieth Century Fund Survey. By J. F. Dewhurst and Associates. The Twentieth Century Fund, New York, N. Y., 1947. Cloth, $7 \times 10^1/_4$ in., 812 pp., charts, tables, $5. Beginning with a survey of our wartime production and using the available reliable records of past economic changes, this volume contains basic estimates of future employment and productivity, and of population, income, consumption, and expenditure patterns of the future. The extensive statistical information is presented in over 250 tables. On the basis of this information concerning previous years, the demands and needs of 1950 and 1960 are estimated. Detailed analyses are presented of such items as passenger traffic, crop yields per acre, and retail purchases of various commodities. Containing over 800 pages, including a 20-page index, this comprehensive study of our entire economic system is intended as a basic framework for future planning.

APPLIED THERMODYNAMICS. By V. M. Faires. The Macmillan Co., New York, N. Y., 1947. Cloth, $6 \times 9^1/_2$ in., 480 pp., illus., diagrams, charts, tables, $4.75. The theories of thermodynamics involved in engineering problems are covered in an elementary fashion by this text. It is designed to be understandable to those who have not previously studied heat engines. The revised edition contains a more extensive treatment of the second law of thermodynamics, more material on the internal-combustion turbine, and a chapter on heat transfer. Illustrations and equations have been added. The customary material for a thermodynamics course constitutes the main framework of the book.

CENTRIFUGAL CASTING OF METALS IN GERMANY, Fiat Final Report No. 81, September 21, 1945. By J. T. MacKenzie. 21 pp., tables, $2. Latest in CONTINUOUS CASTING FROM GERMANY. 13 pp., apply for price. Hobart Publishing Company, Bond Building, Washington 5, D. C. Paper, $8^1/_2 \times 11$ in. The centrifugal-casting report, while strictly factual in scope, covers several products, pipe, engine cylinders, etc., including both ferrous and nonferrous compositions. Continuous ingot casting of brass and the light metals and alloys is dealt with at more length in the other report, with information concerning the developmental work on the mechanical and metallurgical aspects.

CHEMISTRY AND TECHNOLOGY OF PLASTICS. By R. Nauth. Reinhold Publishing Corporation, New York, N. Y., 1947. Cloth, $6 \times 9^1/_4$ in., 522 pp., illus., tables, $9.50. Preparation and properties are given for thermosetting resins, thermoplastic resins, cellulose plastics, synthetic rubbers, natural resins, and plywood. Mold design and equipment for plastic products are described. Many charts, pictures, and diagrams provide much technical data. Many patents pertinent to various plastics are listed.

CONDUCTION OF HEAT IN SOLIDS. By H. S. Carslaw and J. C. Jaeger. Clarendon Press, Oxford, England; Oxford University Press, New York, N. Y., 1947. Cloth, $6^1/_4 \times 9^3/_4$ in., 386 pp., diagrams, charts, tables, $8. Based on the earlier "Introduction to the Mathematical Theory of Conduction of Heat in Solids," this volume has been rewritten and brought up to date. The general theory is given together with its application to the linear flow of heat and to the flow of heat in a rod, rectangular parallelepiped, circular cylinder, sphere, and cone. The Laplace Transformation method of dealing with problems in the conduction of heat is used instead of the older method of contour integrals. The authors have attempted to make this edition useful to engineers and physicists without altering its character as a mathematical work. There are over four hundred footnote references.

COST ACCOUNTING, Fundamentals and Procedures. By C. L. Van Sickle. Second edition. Harper & Brothers, New York, N. Y., and London, England, 1947. Cloth, $6 \times 9^1/_2$ in., 889 pp., diagrams, charts, tables, $7.50. Designed to show the relationships between cost accounting and the fields of factory management, marketing, and administrative management, this book covers such topics as cost applications, factors, elements, systems, and adaptations. Budgetary control and general cost accounting are discussed. This second edition has been revised slightly by the addition of a chapter on cost accounting and cost control, and the omission of the chapter on mechanical appliances used in compiling costs. Other revisions affect the chapters on standards and flexible budgets, provide for the condensation of three chapters on market cost systems into one, and the condensing of the material on the general principles of budget control. Over 200 pages are devoted to practical, illustrative problems. There is a bibliography.

DICTIONARY OF MACHINE SHOP TERMS. By A. C. Tolford. American Technical Society, Chicago, 1947. Paper, $3 \times 5^1/_4$ in., 292 pp., $0.75. All the terms with which a mechanic should be familiar in order to pursue his trade effectively are briefly defined in this small volume. A number of words and terms not directly related to shop work are included for their value in general use.

DIESEL ENGINE CATALOG, Volume 12. Edited by R. W. Wadman, W. W. Young, and B. C. Sisson. Diesel Engines, Inc., New York, N. Y., 1947. Fabrikoid, $10^3/_4 \times 13^3/_4$ in., 519 pp., illus., diagrams, charts, tables, $10. Presenting a cross section of the Diesel industry, this volume describes in detail all of the engines available, including new designs developed in the past year. Some forty pages are devoted to various accessories. Following a large advertising section there is an extensive

Library Services

ENGINEERING Societies Library books may be borrowed by mail by A.S.M.E. members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

classified listing of manufacturers of engines and accessories. The book is profusely illustrated by photographs, drawings, and diagrams of engine performance and characteristics.

ELEMENTS OF AEROFOIL AND AIRSCREW THEORY. By H. Glauert. Second edition. University Press, Cambridge, England; The Macmillan Co., New York, N. Y., 1947. Cloth, $5^1/_2 \times 8^3/_4$ in., 232 pp., diagrams, charts, tables, $4. The object of this book is to give an account of airfoil and airscrew theory in a form suitable for students without a previous knowledge of hydrodynamics. The first five chapters give a brief introduction to those aspects of hydrodynamics which are required for the development of airfoil theory. The following chapters deal with airfoil lift, the effect of viscosity and its bearing on airfoil theory, the theory of airfoils of finite span, and the development of airscrew theory. Particular changes in the new edition have been made in the theory of viscous motion and the boundary-layer flow. Complex mathematical analysis has been avoided in so far as possible.

GAS DYNAMICS TABLES FOR AIR. By H. W. Emmons. Dover Publications, Inc., New York, N. Y., 1947. Paper, $6 \times 9^1/_4$ in., 46 pp., diagrams, charts, tables, $1.75. After presenting the general relations of gas dynamics and the shock-wave equations, the technique of using the five-place tables is explained. There are four groups of tables as follows: isentropic gas dynamics functions for air, gas dynamics functions for normal shocks, characteristics table, and acoustic velocity-temperature table. Nineteen graphs of tabulated functions follow the tables themselves. The tables were in part produced originally in connection with aircraft research.

HEAT-TREATMENT OF STEEL. By E. Gregory and E. N. Simons, with a foreword by C. K. Everitt. Sir Isaac Pitman & Sons, Ltd., London, England, 1947. Cloth, $5^1/_2 \times 8^3/_4$ in., 358 pp., illus., diagrams, charts, tables, $4. Beginning with temperature measurement by means of thermocouples and the various types of pyrometers, this book proceeds to the description of the types and operation of gas, fuel-oil, and electric furnaces. Refractories, atmosphere control, heating baths, and quenching equipment are dealt with. The remaining half of the book is devoted to the principles and processes of heat-treatment and their application to all types of steel production, including spheroidizing, austempering, casehardening, cyaniding, nitriding, and flame and induction surface-hardening.

INVENTIONS, PATENTS AND MONOPOLY. By P. Meinhardt, with a foreword by J. Mould. Stevens & Sons, Ltd., London, England, 1946. Cloth, $5^1/_2 \times 8^3/_4$ in., 352 pp., tables, 25 s. Containing concise information concerning British patent-law practice and procedure, this volume is divided into four parts. Part 1 is concerned with the characteristics of inventors and inventions; Part 2, the major portion of the volume, with a concise description of the law and practice. Characteristics of a patentable invention, patent-application procedure, grant of patents, maintenance of patents, and other topics are discussed. Part 3 is concerned with abuse of patent monopoly; and Part 4 with suggestions for reform.

LIFE AND WORK OF WILLIAM CAWTHORNE UNWIN. By E. G. Walker, with an introduction by Sir A. Chatterton. George Allen and Unwin, Ltd., London, England, 1947. Cloth, $5^1/_2 \times 8^3/_4$ in., 239 pp., illus., 12s 6d. Extending from 1838 to 1933, the life span of William Cawthorne Unwin was coincident with the greatest period of development of British engineering. This book describes his background, life, and achievements as engineer, scientist, and educator. Extensive quotation from contemporary letters and documents effectively reproduces the events and feeling of the times. A group of appreciatory letters by noted men and a bibliography of Unwin's published works conclude the book.

MANUAL FOR PROCESS ENGINEERING CALCULATIONS. By L. Clarke. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1947. Cloth, $6 \times 9^1/_4$ in., 438 pp., charts, maps, tables, $6. This volume represents a concise, practical summary of data to aid engineers in more simply and rapidly performing calculations in the development of chemical processes. It features self-explanatory tables, charts, and equations which are of the most use in process engineering, including a listing of symbols, their significance, and units. The material covers conversion factors, physical and mechanical properties, equipment, performance factors, and briefs of the theory involved in unit operations common to many processes.

MANUAL OF FOUNDRY AND PATTERN SHOP PRACTICE. By O. Benedict, Jr. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1947. Fabrikoid, $5 \times 7^3/_4$ in., 361 pp., illus., diagrams, charts, tables, $3.25. Intended for use in engineering schools, this volume presents the fundamental processes of pattern design and construction, molding, cupola operation, pouring, cleaning, and inspection of castings. The basic language is defined and directions are given for the operations described. Standards applying to the topic under discussion are given, and a list of visual aids—film strips and so on—is correlated with the text. The material on foundry processes constitutes Part 1, while Part 2 covers the pattern design and construction, including twenty-five practical design problems.

MATERIALS HANDBOOK. By G. S. Brady. Sixth edition. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1947. Cloth, $5^1/_4 \times 8^1/_2$ in., 831 pp., charts, maps, tables, $7. Useful to purchasing executives and product engineers, this book is a descriptive encyclopedia of industrial materials. It contains general information and patented and trade names of some processed and many raw materials. Detailed specifications are not given. The book is divided into two parts. Part 1 is devoted to definitions; Part 2 to a condensed handbook of general information ranging in scope from economic data to elementary nuclear physics. Statements regarding the characteristics of the materials and nomenclature used are data backed by competent authorities or are common usage of well-known manufacturers.

METALLURGY FOR AIRCRAFT ENGINEERS, INSPECTORS AND ENGINEERING STUDENTS. By R. A. Beaumont. Sir Isaac Pitman & Sons, Ltd., London, England, 1946. Cloth, $5^1/_2 \times 8^3/_4$ in., 273 pp., illus., diagrams, charts, tables, 25 s. This book deals chiefly with alloy structural steels, case-hardening steels, light alloys, and copper and its alloys which are used in aircraft construction. The production of steel, mechanical methods of working steel, steel-composition, structure, and heat-treatment, defective materials and processes, mechanical testing, and temperature measurement equipment are considered. Tables of specifications are given for the steels, copper, and their alloys which are discussed.

MODERN PETROLEUM TECHNOLOGY, published by Institute of Petroleum, London, W. 1, England, 1946. Cloth, $6 \times 9^1/_4$ in., 466 pp., illus., diagrams, charts, maps, tables, 21 s. In order to make available the knowledge of the expert in one field of petroleum technology to those engaged in other branches of the industry, the British Institute of Petroleum has sponsored this volume with the intention of giving a composite picture of present conditions. Exploration, prospecting, production, refining, chemistry, utilization, distribution, measurements, tests, and economic features of petroleum are the main topics. Large topics, such as refining, are subdivided into the important phases, and different specialists write of the state of knowledge in their own sections. Some of the most important advances, made in wartime and only recently released, are included.

ORGANIZATION AND MANAGEMENT IN INDUSTRY AND BUSINESS. By W. B. Cornell. Third edition. Ronald Press Company, New York, N. Y., 1947. Cloth, 6×9 in., 819 pp., illus., diagrams, charts, tables, $5. Intended for use in schools of commerce and colleges of engineering, this text presents detailed information on the varied subjects included in the field. Broad in scope, the volume covers the topics of organization and operation of a business enterprise, production control, and time study. Concrete examples are given of problems solved for well-known manufacturers. For each topic discussed, details of practical value are presented. This third edition has been revised to include up-to-date practices. New approaches to the solution of problems such as those of personnel administration have been added.

PHENOPLASTS, Their Structure, Properties, and Chemical Technology. (High Polymers, vol. 7). By T. S. Carswell. Interscience Publishers, New York, N. Y., and London, England, 1947. Cloth, $6 \times 9^1/_4$ in., 267 pp., illus., diagrams, charts, tables, $5.50. Continuing the series on high polymers, this volume considers the physical and chemical structure of phenoplasts, and correlates their structure with their mechanical and chemical properties. It is not a handbook on phenoplast manufacture. An attempt has been made to cover the literature of the past ten years, and ample reference to this literature is given. Fillers for phenoplast molding powders and fillers and resins for phenoplast laminates are discussed. Attention is given to the mechanical properties of molded and laminated phenoplasts, electrical and thermal properties, chemical resistance, and oil-soluble phenoplasts. Miscellaneous technical applications of phenoplasts are indicated.

PHYSICAL CHEMISTRY AND THE TECHNOLOGY OF FUELS. (Twenty-First Annual Priestley Lectures.) By A. W. Gauger, sponsored by Phi Lambda Upsilon and the department of chemistry, Pennsylvania State College, State College, Pa., 1947. Paper, $8^1/_2 \times 11$ in., 114 pp., diagrams, charts, tables, $2. Reviewing the present state of our knowledge of fuels, this volume emphasizes the particular aspects of interest to physical chemists. The book is based on the twenty-first annual Priestley lecture with the addition of background material on fuels. It is divided into six sections: the composition and properties of fuels; interconversion of solid, liquid, and gaseous fuels; gasification of solid and liquid fuels; the physical chemistry of combustion; fuels

as chemical raw materials; and the nuclear-energy power plant. A brief list of reference material is included.

PRACTICAL GUIDE TO PREFABRICATED HOUSES. By A. L. Carr. Harper & Brothers Publishers, New York, N. Y., and London, England, 1947. Cloth, $6\frac{1}{2} \times 10\frac{1}{4}$ in., 111 pp., illus., diagrams, $2.75. Giving examples of the work of twenty-one American prefabrication experts, the volume presents an over-all picture of this field. A history of prefabrication is given and its advantages and problems are discussed. More than 100 photographs show the accomplishments possible using prefabrication technique. Facts about the companies and the type of house they build are noted. A directory of companies specializing in prefabricated houses, and a checklist of things to look for in buying a home are included.

PRACTICAL THEORY OF MECHANISMS. By P. Grodzinski. Emmott & Co., Ltd., Manchester, England, 1947. Cloth, $4 \times 6\frac{3}{4}$ in., 166 pp., diagrams, charts, tables, 7s, 6d. Presenting an introduction to the basic principles of the theory of mechanisms, this book endeavors to make the reader realize the value of these ideas in dealing with all engineering problems. As an aid to understanding, the author isolates the mechanism from its machine and neglects forces, speeds, accelerations, etc. The screw mechanism, the four-bar link and derived mechanisms, cams, gear trains, belt and fluid drives, and ratchets are the basic mechanisms discussed. The book is a revised and enlarged translation of the author's "Angewandte Getriebelehre".

PRESSURE VESSELS FOR INDUSTRY. By H. M. Spring, Jr. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1947. Cloth, $5\frac{1}{2} \times 8\frac{1}{4}$ in., 259 pp., illus., diagrams, charts, tables, $3.50. A practical guide to the design, construction, operation, selection, and maintenance of industrial pressure vessels. Explaining how various types of vessels are operated most efficiently, the book discusses how they are fabricated, treats the factors determining maximum safe working pressures, and describes the causes and remedies of many defects. It covers such equipment as compressed-air tanks, evaporators, pressure filters, digesters, autoclaves, and so on. Accident-prevention procedures and appliances for safety and economy of operation are also presented.

PROPERTIES OF ENGINEERING MATERIALS. By G. Murphy. Second edition. International Textbook Co., Scranton, Pa., 1947. Cloth, $6 \times 9\frac{1}{2}$ in., 459 pp., illus., diagrams, charts, tables, $4.50. In dealing with the properties of engineering materials, special emphasis is placed upon the specific properties which are of major importance to the student of engineering. Material is presented to emphasize the basic principles underlying the behavior of engineering materials under conditions of usage. The behavior of materials under load, failure of materials, use of properties in design, qualities other than strength, and control of the properties of materials are discussed as well as the important specific materials themselves.

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, Proceedings, Vol. 4, No. 2. Edited by C. Lipson and W. M. Murray; published and distributed by Addison-Wesley Press, Inc., Cambridge, Mass., 1947. Cloth, $8\frac{1}{2} \times 11\frac{1}{4}$ in., 121 pp., illus., diagrams, charts, tables, $6. A history of the Society, lists of members, and twelve papers are presented in this volume. The papers are as follows: Fatigue Tests of Major Aircraft Structural Components; Precision Determination of Stress-Strain Curves in the Plastic Range; A Method of Detecting Incipient Fatigue Failure; A Machine for Fatigue Testing Full-Size Parts; Some Repeated Load Investigations on Aircraft Components; Stress Analysis Utilization in Dynamic Testing; Device for Maintaining Continuous Electrical Connections With Reciprocating Engine Parts; Evaluation of Various Methods of Rotor-Blade Analysis by Means of a Structural Model; Reluctance Gages for Telemetering Strain Data; The Linear Variable Differential Transformer; Design and Application of Accelerometers; Aircraft Instruments for Radio-Telemetering and Television-Telemetering.

STRUCTURE OF CAST IRON. By A. Boyles. American Society for Metals, Cleveland, Ohio, 1947. Cloth, $6 \times 9\frac{1}{4}$ in., 154 pp., illus., diagrams, charts, tables, $3.25. The three lectures contained in this book deal with the structure of the common gray-iron alloy as determined by the mechanisms of freezing and transformation. Familiarity with the iron-carbon diagram and with the concept of the stable and metastable conditions of equilibrium is required. General foundry practice, the relationship between composition and physical properties in cast iron, and special alloy elements are not discussed. References to the literature are cited.

SURFACE STRESSING OF METALS. By H. F. Moore and others. American Society for Metals, Cleveland, Ohio, 1947. Cloth, $6 \times 9\frac{1}{4}$ in., 197 pp., illus., diagrams, charts, tables, $3.50. Five lectures presented at the 1946 National Metal Congress are contained in this volume. The topics covered are: the definition of the problem of surface stressing of metals; the measurement of surface stresses; fatigue of metals as influenced by design and internal stresses; stressing axles, etc., by cold rolling; the interpretation and determination of progressive stress-damage. Bibliographies are included.

TABLES NUMÉRIQUES UNIVERSELLES des Laboratories et Bureaux d'Étude. By M. Boll. Dunod, Paris, 1947. Stiff cardboard, 7×11 in., 881 pp., diagrams, charts, tables, 3200 fr. This comprehensive work presents for the use of the laboratory or research worker a collection of more than 200 useful tables covering arithmetical and algebraic operations, trigonometric expressions, exponentials, probabilities, complex numbers, constants, and conversion tables of units. The material varies from simple, general, numerical expressions to special calculations, and in more than half of the cases a graphical illustration is provided by a diagram. Interpolation methods are described and a detailed subject index is included. Terms are carried out to 8 or 10 places, although 5 to 6 places or less are more generally supplied, depending on the character of the items in question.

TABLES OF THE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDERS FOUR, FIVE, AND SIX (Annals of the Computation Laboratory of Harvard University, Vol. 5). TABLES OF THE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDERS SEVEN, EIGHT, AND NINE (Annals of the Computation Laboratory of Harvard University, Vol. 6). By the Staff of the Computation Laboratory of Harvard University. Harvard University Press, Cambridge, Mass., 1947. Cloth, 8×11 in., no pagination, tables, $10 each. Continuing the Annals of the Computation Laboratory of Harvard University, volumes 5 and 6 contain 10-place tables of the Bessel functions of the first orders, $J_n(X)$ for n equal to 4, 5, and 6 and for n equal to 7, 8, and 9. The tables were computed on the Automatic Sequence Controlled Calculator. A description of the techniques employed may be found in volume 3 of this series. Included in volume 5 is a method of interpolating in the tables by means of the Taylor expansion. In both volumes the argument interval is .001 for X between 0 and 25, and .01 for X between 25 and 100.

THEORY AND APPLICATION OF MATHIEU FUNCTIONS. By N. W. McLachlan. Oxford University Press, New York, N. Y.; Clarendon Press, Oxford, England, 1947. Cloth, $6 \times 9\frac{1}{2}$ in., 401 pp., diagrams, charts, tables, $12.50. Addressed to the technologist, the purpose of this volume is to give the theory of Mathieu functions and to demonstrate their application to representative problems in physics and engineering science. These applications are taken from the fields of radio, acoustics, mechanics, heat conduction, electromagnetism, and others in which oscillatory effects occur. A short historical introduction and a bibliography are included. Although not written for mathematicians, the mathematical treatment is thoroughly carried out.

THERMODYNAMIQUE DES SYSTÈMES PROPULSIFS A RÉACTION ET DE LA TURBINE A GAZ. By M. Roy. Dunod, Paris, France, 1947. Paper, $6\frac{1}{2} \times 10$ in., 160 pp., diagrams, charts, tables, 540 fr. The thermodynamic characteristics of reaction propulsion systems are discussed in considerable detail. Rockets and jet-propulsion units are dealt with both in entirety and by their separate elements. The various methods of propulsion, simple and combined, are classified and described separately. The final chapter gives brief consideration to the thermodynamics of the various gas-turbine cycles.

VECTOR AND TENSOR ANALYSIS. By L. Brand. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1947. Cloth, $5\frac{1}{2} \times 8\frac{1}{2}$ in., 439 pp., diagrams, tables, $5.50. The theory and simpler applications of vector and tensor analysis in ordinary space are covered, including significant applications of the concepts of dyadics, matrixes, "motors," and quaternions. Surface geometry and hydrodynamics are treated at some length in separate chapters. Nearly all of the important results are formulated as theorems in which the essential conditions are explicitly stated. There are problems at the end of each chapter.

WATKINS CYCLOPEDIA OF THE STEEL INDUSTRY. First edition. Steel Publications, Inc., Pittsburgh, Pa., 1947. Cloth, $8\frac{1}{4} \times 11\frac{1}{2}$ in., 375 pp., plus 93 pp. Directory and Advertisers Index, illus., diagrams, tables, $10. This book describes briefly modern procedures as required for performing the operations that are employed in the manufacture of steel, from the treating of iron ores to the handling of the finished product. Such processes as beneficiation, nodulizing, and sintering are discussed. The blast furnace, the open hearth furnace, the Bessemer converter, the electric furnace, and the cupola are dealt with. Rolling and shaping of steel, forging and welding of steel, metal finishing and cleaning, and the inspection and testing of steel are mentioned. Statistics on coke, iron, and steel are given for the years 1942–1945. Steel plant refractories, carbon and alloy steels, the fabricating of steel and the steel processing furnace are subjects treated. Pictures and descriptions of equipment used in the industry are given, together with the companies from whom the quipment may be obtained. References to the sources of data, a trade directory, and a buyers guide are included.

A.S.M.E. NEWS

And Notes on Other Engineering Societies

COMPILED AND EDITED BY A. F. BOCHENEK

Petroleum Industry Hails A.S.M.E. 1947 Conference on Petroleum Mechanical Engineering as Major Event

CALLED a major event of the petroleum industry by local observers, the 1947 National Conference on Petroleum Mechanical Engineering held at the Rice Hotel, Houston, Texas, Oct. 6-8, 1947, set the stage for a national discussion of the implications of the recent United States Supreme Court decision granting control to the Federal Government of the California oil-rich tidelands. The conference, sponsored by the Petroleum Committee of the Process Industries Division of The American Society of Mechanical Engineers, called together more than 400 mechanical engineers and executives of the petroleum industry to discuss such subjects as intermixing of petroleum products in pipe lines, corrosion of oil-well equipment, the manufacture of composite plates, and others.

Speaking at the banquet on Tuesday, Oct. 7, before more than 500 members and guests, Governor Beauford H. Jester of Texas warned that the California tidelands case introduced "a new legal theory of state-federal relations" which would be used by proponents of nationalization to take over, first, the entire oil and gas industry, and later, other private industries.

Large Area Involved

"The marginal sea surrounding our nation out to the three-mile limit includes 65,000 square miles of land, as large as the five New England States combined," he said. "Transplanting the former control of the respective states over this great area to the Federal Government would seem to be a drastic step toward further federalization and overcentralization of our government."

Engineers attending the meeting were of the general opinion that the decision was unfortunate because tremendous sums have been spent on research for tidelands oil production by many oil companies in competition trying to beat each other to patents. Federal ownership of tidelands would stifle research and cripple production because some of the great oil deposits of the Texas and Louisiana coasts may not be located for a long time to come.

Success of the conference was due in a large measure to the splendid co-operation and hospitality of the A.S.M.E. South Texas Section and engineers of the Houston industries, whose arrangements for social events and plant-inspection trips made the conference one of the most memorable in years.

Proceedings to Be Published

To cover the cost of the conference and publication of proceedings containing all the technical papers on the program, a registration of $5 was charged to members and $10 to nonmembers. The proceedings will be distributed free of charge to all who registered. Others may obtain the 1947 proceedings from Publications Sales, A.S.M.E., 29 West 39th Street, New York 18, N. Y. for $5 per copy.

President Eugene W. O'Brien was among the A.S.M.E. officers who attended the conference. Speaking at the Welcome Luncheon on Monday, Oct. 6, President O'Brien referred to the industrial potentialities of the Southwest and discussed provisions of the Taft-Hartley Labor Law of interest to engineers.

"With its resources and fuel, the South's gain in industrialization is continuing to mount," he said. "We are beginning to pay our help more, and therefore the wage differential between the North and South is being wiped out. This assures the South the needed industrial man power."

Referring to the new labor law, President O'Brien said, "now the engineer cannot be forced to unionize with nonprofessional workers."

Intermixing in Pipe Lines

One of the high lights of the technical program was a session on intermixing of products in delivery pipe lines. The problem arises when successive batches of different petroleum products are pumped through long-distance pipe-line delivery systems. Intermixing is of economic importance because delivered products must meet specifications and because it tends to lower the flash point of such products as kerosene when in contact with gasoline.

The problem was discussed in three papers

December News High Lights

THREE important A.S.M.E. publications are announced this month: A review of world literature in applied mechanics to be called *Applied Mechanics Reviews* (page 1070); a year book of engineering bodies (page 1065); and a safety self-appraisal form for use by industrial plants (page 1074).

In international affairs, engineers were called upon to contribute to the agenda of the General Conference of UNESCO held in Mexico City (pages 1069 and 1070). Plans for the Eighth International Congress of Applied Mechanics are under way in London, England. American engineers and scientists were invited to participate (page 1069).

The presence of an American delegate at the council meeting of the World Engineering Congress held in Zurich, Switzerland, in September, served to strengthen a new organization struggling under financial difficulties (page 1069).

Mounting prestige of the A.S.M.E. National Conference on Petroleum Mechanical Engineering was reflected in the large and enthusiastic attendance of the 1947 Conference held in Houston, Texas, in October (see pages 1063 to 1065).

The first technical report of the American experiment in underground gasification of coal at Gorgas, Ala., was made at the A.I.M.E.-A.S.M.E. Tenth Fuels Conference at Cincinnati, Ohio (page 1066).

In Society affairs, A.S.M.E. Council actions on 19 recommendations of the Regional Delegates Conference were made available (page 1071 to 1073).

Editors of the *Junior Forum* strike a pessimistic note because of disappointing returns from junior members (page 1071 to 1073).

In A.S.M.E. Section affairs, the Detroit Section set the stage for an important statement on the steel industry by one of its prominent spokesmen (page 1075). October Section meetings reported in this issue reflect widespread participation of members in Section programs (pages 1075 to 1079).

Reports from 47 of the 123 A.S.M.E. Student Branches reflect record-breaking activity on the part of more than 10,000 A.S.M.E. student members. At a majority of the October meetings, members of the Society were present to explain the advantages of Society membership and to invite students to attend A.S.M.E. Section meetings. Of the meetings reported, 24 were attended by more than 100 students, several by more than 250 (pages 1080 to 1084).

by engineers of companies having extensive experience with pipe-line systems. S. S. Smith of the Shell Oil Company, Inc., New York, N. Y., described the pilot plant built by his company for studying intermixing and reported some of the data obtained after several years of testing with a wide variety of fuels. He described a continuous stream gravitometer whose development assured success of the test work.

Edwin A. Birge of the Plantation Pipe Line Company, Atlanta, Ga., discussed some of the factors which affect intermixing and listed desirable features of a good pipe-line system. He said that the size of pipe should be such that turbulent flow can be maintained at all times. New systems, he said, should be single-tube systems for "closed-line" operation without the use of "float" tanks which increase intermixing.

The discussion was carried further by D. A. Roach of the Phillips Petroleum Company, Bartlesville, Okla. The experience of his company, he said, indicated "that the length of the intermixed or co-mingled portion between successive slugs tends to increase very little with continuing line travel," and that the length of the intermixed portion was "proportional to the number of stations through which the products had been handled. The source of this increase he attributed to the "dead fluid" in station bypasses and equipment.

Oil-Well Corrosion

Oil-well corrosion, a major economical and technical problem of the petroleum industry,

GOVERNOR BEAUFORD H. JESTER OF TEXAS, SPEAKING AT THE BANQUET OF THE CONFERENCE ON PETROLEUM MECHANICAL ENGINEERING, HOUSTON, TEXAS

was discussed by L. C. Case of the Gulf Oil Company, Tulsa, Okla. Study of operation records of Midwestern and Southwestern wells show that "severe corrosion occurs only where appreciable water is produced and where the water has certain general characteristics," he said. Severe corrosion can be predicted by the percentage of water produced but the critical percentage is modified by the wetting ability of the oil and the nature of the water. In general, small amounts of hydrogen sulphide in acid water may cause severe corrosion while large amount of compound in alkaline water can be relatively noncorrosive. For combating hydrogen-sulphide corrosion, Mr. Case said that the best methods so far developed in Kansas pumping wells has been the formaldehyde treatment. Oil wetting agents are currently being tried. While they hold considerable promise, their effectiveness has not yet been time-tested.

Alloy-Clad Plates

A new variation of the slabbing process for bonded composite plates, recently developed by the Babcock and Wilcox Company, was described by O. R. Carpenter at the pressure-vessel-design session. The clad layer, usually made of three layers, consisting of two of the alloy materials and one of pure nickel, are secured to the steel base by overlapping welds which give an area of bond equal to approximately 75 per cent of the total. The welds are made by a new welder of a type hitherto not used for seam welding. The new machine has two rotary-type transformers in contrast to the conventional transformer which is stationary. The transformers are part of the welder carriage and move along the supporting cross beam at a fixed rate during the welding operation. Operation of the welder is characterized by more consistent welding voltage, considerable power savings, and higher current flow into the work for shorter periods.

A.S.M.E. MEMBERS WHO ENJOYED A TWO-HOUR FLIGHT OVER THE INDUSTRIAL AREA OF SOUTHWEST TEXAS, AS GUESTS OF THE HUMBLE OIL AND REFINING COMPANY. PRESIDENT O'BRIEN IS IN THE CENTER. CARL E. REISTLE, JR., CHAIRMAN, GENERAL ARRANGEMENTS COMMITTEE, IS STANDING ON THE EXTREME RIGHT

Matthew Luckiesh Awarded I.E.S. Gold Medal

MATTHEW LUCKIESH, director, Lighting Research Laboratory, General Electric Company, Cleveland, Ohio, has been awarded the Gold Medal of the Illuminating Engineering Society. This award, the highest conferred by the I.E.S., is in recognition of "meritorious achievement which has conspicuously furthered the art or knowledge of illuminating engineering." The medal was presented to Dr. Luckiesh at the banquet of the I.E.S. 1947 National Technical Conference held in New Orleans during the week of September 15, 1947.

Engineering Societies Yearbook Announced

PUBLICATION is scheduled for December of the first edition of "The Engineering Societies Yearbook." It is being published by The American Society of Mechanical Engineers under the sponsorship of the Engineers Joint Council.

The Yearbook will contain data on joint engineering bodies, and 300 national, state, regional, and local engineering clubs, societies, and councils in the United States. It will also describe the international engineering bodies and will list the names and locations of engineering societies now known in this country to be functioning in foreign countries.

The data from United States bodies, obtained by questionnaire, cover date of founding, offices, sections, purposes of organization, affiliations, number of members and student branches, grades and qualifications of members, dues, budget, names of president and secretary for the current and coming year, names of committees, and technical divisions.

The Yearbook also covers meetings, publications, awards, and new developments of the past year. It is expected to serve the staff needs of the various societies in their liaison work. It will also be of value to industry, trade associations, colleges, trade publications, and government.

It is expected that its publication will be continued at annual intervals. The cost will be between $2 and $3 per copy. Subscription orders should be sent to Publication Sales, A.S.M.E., 29 West 39th St., New York 18, N. Y.

C. P. McCormick Receives S.A.M. Award

CHARLES P. McCORMICK, chairman and president of McCormick and Company, Inc., Baltimore, Md., was the recipient recently of the Human Relations Award presented by the Society for the Advancement of Management for outstanding performance in the development of human relations in industry in the year 1946.

The presentation was made to Mr. McCormick by Phil Carroll, Jr., member A.S.M.E., consulting industrial engineer, Maplewood, N. J., at the society's annual National Conference on Human Relations held at the Hotel Netherland-Plaza, Cincinnati, Ohio, Oct. 30, 1947.

The citation read in part: "Because you have developed in your own company a method of taking your supervisory forces into your confidence and making them in fact a part of management, thereby creating a feeling of understanding and co-operation throughout your entire organization. Because you have reduced your method to a practical working formula, which you call multiple-management, and thus made its benefits available to other companies. And because you have been untiring in your efforts to spread both here and abroad the philosophy that the safeguarding of the dignity of man is the key to the successful operation of any business."

PRES. EUGENE W. O'BRIEN REGISTERING AT THE NATIONAL CONFERENCE ON PETROLEUM MECHANICAL ENGINEERING. W. H. STUEVE, OKLAHOMA GAS AND ELECTRIC COMPANY, IS IN THE BACKGROUND

Brochure on Psychrometry Published by A.S.R.E.

A BOOKLET, "A.S.R.E. Brochure on Psychrometry," helpful in simplifying engineering calculations in psychrometry, has been published by the American Society of Refrigerating Engineers.

The booklet includes three complete psychrometric charts covering the low, normal and high temperature ranges. Adequate tables are also included which make it possible to adapt the charts for solving problems when the barometer or altitude deviates from standard.

The booklet was written by E. P. Palmatier, member A.S.M.E., Carrier Corporation, Syracuse, N. Y., and D. D. Wile, formerly associated with the Carrier Corporation. Copies may be obtained from A.S.R.E., 40 West 40th St., New York, N. Y., at $1 per copy.

N.S.P.E. Names W. F. Ryan for Vice-President

WILLIAM F. RYAN, Fellow A.S.M.E. assistant engineering manager, Stone and Webster Engineering Corporation, Boston, Mass., has been nominated for vice-president, northeastern area, of the National Society of Professional Engineers for 1948.

Recently Mr. Ryan served as A.S.M.E. representative on the Engineering Societies Labor Legislation Panel organized by the Engineers Joint Council to give legislators the viewpoint of engineers on pending labor legislation.

Other N.S.P.E. nominations are: Alex Van Pragg, Jr., for president; Lawrence Peterson for vice-president, central area; Robert Coltharp for vice-president, southern area; A. J. Shaver for vice-president, western area; and Russell B. Allen, secretary.

W. A. Pennington Honored by A.S.M.

W. A. PENNINGTON, chief chemist and metallurgist of the Carrier Corporation, Syracuse, N. Y., received the Henry Marion Howe Medal for 1947 of the American Society for Metals at the annual banquet of the society on Thurday, Oct. 23, 1947.

The award is made annually to the author or authors of the technical paper of highest merit published in the A.S.M. annual Transactions. Dr. Pennington's paper, "A Mechanism of the Surface Decarburization of Steel," was published in 1946.

The medal is awarded in memory of Dr. Henry Marion Howe, professor of metallurgy at Columbia University, New York, N. Y., for 25 years. Dr. Howe's contribution to science was his development of the technique of visual inspection of metals under high-power microscopes.

A.S.M.E. Calendar

of Coming Events

March 1–5, 1948
A.S.M.E. Spring Meeting
New Orleans, La.

May 20–22, 1948
Oil and Gas Power Division Meeting
St. Louis, Mo.

May 30–June 5, 1948
A.S.M.E. Semi-Annual Meeting
Milwaukee, Wis.

Sept., 1948
A.S.M.E. Fall Meeting
Portland, Ore.

Nov. 28–Dec. 4, 1948
A.S.M.E. Annual Meeeting
New York, N. Y.

First Report on Underground Gasification Made at Tenth National Fuels Conference

THE first technical report of the historic American experiment in the underground gasification of coal was made to more than 200 members and guests of the Coal Division of The American Institute of Mining and Metallurgical Engineers and the Fuels Division of The American Society of Mechanical Engineers who attended the banquet of the Tenth National Fuels Conference. The conference was sponsored by both organizations and was held at Hotel Gibson, Cincinnati, Ohio, Oct. 20 and 21, 1947.

While underground gasification of coal has been discussed by engineers for more than 50 years, and while Russia claims from behind the "iron curtain" that a successful underground-gasification technique has been developed in that country, the paper presented by M. H. Fies and W. C. Schroeder was the first in which data of a technical nature were made available to engineers.

Mr. Fies is manager of coal operations, Alabama Power Company, Birmingham, Ala., and Mr. Schroeder, member A.S.M.E., is chief of Office of Synthetic Liquid Fuels, U. S. Bureau of Mines, Washington, D. C. Their paper will be published in a future issue of MECHANICAL ENGINEERING.

The experiments at Gorgas, Ala., were made in a hilltop 450 ft long and about 350 ft wide, where 30 to 40 ft under the surface lay the Pratt bed, a seam of high-volatile bituminous coking coal approximately 36 in. thick. The purpose of this first experiment, made early this year, was to determine whether coal in a solid stratum could be burned underground, whether such combustion could be controlled, and what would happen to the rock structure above the seam as a result of high temperature.

The experiments showed: (1) That coal could be burned and gasified completely underground with little loss of combustible material; (2) that combustion could be maintained without difficulty; (3) that coking precedes actual combustion and produces a coke bed that should be satisfactory for producer or water-gas operation; and (4) that roof material may cave in following combustion of the coke but this does not stop flow of air or combustion but does increase back pressure of the blower.

In a ceremony preceding the underground-gasification paper, Alex D. Bailey, Fellow and past-president, A.S.M.E., presented the Percy Nicholls Award to Howard Nicholas Eavenson, president of the Bituminous Research, Inc. The award was established in 1942 and is bestowed annually by the A.I.M.E. and A.S.M.E. in recognition of notable scientific or industrial achievement in the field of solid fuels.

Mr. Eavenson is a past-president of the A.I.M.E. and was instrumental in founding the A.I.M.E. Coal Division. The citation read in part: "His whole professional life has been devoted to the science and art of mining coal. His skill in the application of sound economic principles to the exploitation and production of solid fuel has earned him world-wide recognition in his profession.

In addition to the banquet and two luncheons, the program of the meeting consisted of four technical sessions at which eight papers were presented covering many of the top problems of coal production and utilization.

H. N. EAVENSON, 1947 PERCY NICHOLLS AWARD RECIPIENT

J. Schuyler Casey Elected U.E.T. President

J. SCHUYLER CASEY, Fellow A.S.M.E., and president, M. H. Treadwell Company, Inc., New York, N. Y., was elected president of the United Engineering Trustees, Inc., at its annual meeting on October 23, 1947, in the Engineering Societies Building, New York, N. Y. He succeeds J. P. H. Perry, vice-president, Turner Construction Company, who served as president of United Engineering Trustees from 1945 to 1947.

Others officers elected were: General William H. Harrison, vice-president and chief engineer, American Telephone and Telegraph Company, New York, N. Y., and director, procurement and distribution service, Office of Chief Signal Officer, Washington, D. C. (re-elected) as vice-president; Edward C. Meagher, assistant to the president, Texas Gulf Sulphur Company, New York, N. Y., as vice-president; Kurt W. Jappe, treasurer A.S.M.E., retired director of purchases, Hercules Powder Company, Wilmington, Del., as treasurer; and James L. Head, department of mines, Chile Exploration Company, New York, N. Y., as assistant treasurer. John H. R. Arms, member A.S.M.E. was re-elected secretary.

Irving Huie, president of the Board of Water Supply, New York, N. Y., will head the Real Estate Committee which includes William N. Carey, secretary of the American Society of Civil Engineers; Everett S. Lee, engineer in charge, General Engineering Laboratories, General Electric Company, Schenectady, N. Y.; Mr. Head, Mr. Jappe, and Mr. Casey.

George L. Knight, Fellow A.S.M.E., retired vice-president, Brooklyn Edison Company, Brooklyn, N. Y., will serve as chairman of the Finance Committee. Other members will be Mr. Huie, Mr. Meagher, Mr. Jappe, General Harrison, and Mr. Casey.

United Engineering Trustees is a corporation set up jointly by the four national engineering Founder Societies, which have an aggregate membership of about 88,000. These Societies are: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers and American Institute of Electrical Engineers.

The Corporation promotes the advancement of the engineering arts and sciences in all their branches, through two departments, the Engineering Foundation, and the Engineering Societies Library. The Corporation is the titular owner of the Engineering Societies Building and of the trust funds of the Engineering Societies Library, the Engineering Foundation, the John Fritz Medal Board of Award, and the Daniel Guggenheim Medal Board of Award.

A.S.M.E. Council Actions on Regional Delegates' Recommendations Announced

THE Council of The American Society of Mechanical Engineers after considering 19 recommendations, submitted to it by the Regional Delegates Conference, accepted four, rejected two, referred eight to a vote of the entire membership, and deferred decision on the remainder pending action by other groups, such as the Engineers' Council for Professional Development and the A.S.M.E. Finance Committee.

The actions were taken at the meeting of the Council in the Stevens Hotel, Chicago, Ill., June 17, 1947, on the day following adjournment of the A.S.M.E. 1947 Regional Delegates Conference. This conference, composed of two delegates from each of the eight A.S.M.E. regions, meets annually during the semi-annual meeting to consider recommendations for changes to general Society administration procedure suggested during the year by the 73 Sections of the Society.

Each Section has the privilege to submit recommendations to the agenda committee of the Regional Delegates Conference. If the recommendations are approved by a minimum number of the eight regional administrative conferences held late in the spring, they are placed on the agenda of the Regional Delegates Conference. If approved at this conference, the recommendations are considered by the Council, which makes a final disposition after weighing the opinions of the Society's national committee directly concerned with the recommendation.

The Council's first action was to approve the recommendations that mechanical engineering exhibits be held at annual meetings of the Society. Funds have been allocated for this purpose. An educational exhibit devoted largely to gas turbines, jet-propulsion devices, and nuclear energy exhibits is to be a part of the 1947 Annual Meeting to be held in Atlantic City, N. J., Dec. 1–5, 1947.

In request for a clear statement on the qualifications and duties of council members, the Council directed the Organization Committee to draft a general Society policy and procedure on committee appointments. Such a statement has been drafted and approved by the Executive Committee. it was published on pages 973 and 974 of the November issue of MECHANICAL ENGINEERING.

The Council took favorable note of the request for a study aimed at re-establishing the associate-member grade of membership, but deferred action until the results of a study now being undertaken by the E.C.P.D. Committee on Professional Recognition is reported. This report is expected to recommend uniform requirements for the different grades of membership in the national engineering societies in the United States.

Evidence of dissatisfaction among some members caused the regional delegates to recommend that the Admissions Committee be given more latitude in accepting equivalent experience when judging an applicant's qualifications relating to "responsible charge" of important work in upgrading a junior member. Comment on this subject was published in the Junior Forum, pages 975–977, of the November issue of MECHANICAL ENGINEERING. Since only 16 per cent of the juniors applying for transfer to the member grade were denied during 1946–1947, the Council was of the opinion that the Admissions Committee is fair in its appraisal of equivalent experience of applicants.

A family of eight recommendations, reflecting the desire among many members for action to establish the fellow grade of membership as an honorary grade, was discussed at length by the Council. Because such a change will necessitate changes to the constitution, the Council decided to submit the question to the members in a letter ballot. This was done in the September 25 mailing.

In connection with more personal items in MECHANICAL ENGINEERING, the Council concurred with the Publications Committee in the view that the interests of the Society cover too many diverse fields for an appreciable percentage of A.S.M.E. members to be interested in personal items of a commercial nature, especially since these usually are published by the trade publication which serves the particular industry.

Synopses of articles appearing in MECHANICAL ENGINEERING were requested by the regional delegates, but here again the Council turned down the recommendation in line with action by the Publications Committee. While synopses have value, the Council felt that the increased expense involved and the added burden to the editorial staff could not be justified on the basis of members' interests revealed by the recent reader survey conducted by the staff.

The Council referred to the Finance Committee the recommendation that the Society cover travel expenses for the members of the Agenda Committee of the Regional Delegates Conference.

A complete summary of actions taken by the Council may be obtained by members by writing to headquarters.

Meetings of Other Societies

December 4–6
American Institute of Mining and Metallurgical Engineers, electric furnace steel meeting, Pittsburgh, Pa.

December 14–18
American Society of Agricultural Engineers, The Stevens Hotel, Chicago, Ill.

December 26–31
American Association for Advancement of Science, annual meeting, all principal hotels, Chicago, Ill.

January 21–23
American Society of Civil Engineers, annual meeting, New York, N. Y.

January 26–29
5th All-Industry Refrigeration and Air Conditioning Exposition, Cleveland, Ohio

February 2–6
8th International Heating and Ventilating Exposition in conjunction with the American Society of Heating & Ventilating Engineers, Grand Central Palace, New York, N. Y.

Actions of the A.S.M.E. Executive Committee

At a Meeting Held at Headquarters, Oct. 17, 1947

A MEETING of the Executive Committee of the Council was held in the rooms of the Society, Oct. 17, 1947. There were present: Eugene W. O'Brien, chairman, J. N. Landis, vice-chairman, F. S. Blackall, Jr., A. C. Chick, A. R. Mumford; W. H. Sawyer (Finance Committee), K. W. Jappe, treasurer, E. G. Bailey, president-elect, and C. E. Davies, secretary.

International Boiler Code

The minutes of the Sept. 19 meeting were corrected to authorize the Boiler Code committee to assume full technical responsibility for the international boiler-code project while acting as an autonomous body of the International Standardization Organization. This action was the result of an invitation from the American Standards Association for the Society to participate in an international project to formulate a code for boilers and pressure vessels under the leadership of the International Standardization Organization.

Additional Awards of 1947

Upon recommendation of the Board on Honors, the following additional honors were approved:

Richards Memorial Award: To Jacob P. Den Hartog, member A.S.M.E., professor of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass.

Pi Tau Sigma Gold Medal Award: To David Cochran, Jun. A.S.M.E., development engineer, General Electric Company, Schenectady, N. Y.

Spirit of St. Louis Junior Award: To Harry Hoyt Hauger, Jr., Jun. A.S.M.E., Los Angeles, Calif., for his paper "Thermal Anti-Icing of the Eagle Airfoil."

Junior Award: To Gilbert Thornton Rowe, Jun. A.S.M.E., designer, air conditioning, Douglas Aircraft Company, Santa Monica, Calif., for his paper "A Correlation of Measured and Predicted Flow Characteristics of an Aircraft Ram Air Duct System."

Charles T. Main Award: To Alvaro Richard Boera, student A.S.M.E., Stevens Institute of Technology, Hoboken, N. J., for his paper "The Engineering Method—Its Value and Limitations."

Undergraduate Student Award: To William R. Collier, student A.S.M.E., Tufts College, Medford, Mass., for his paper "Corrosion—A Design Problem."

Regional Delegates Conference

Statements of Council actions on the recommendations of the 1947 Regional Delegates Conference were approved. Copies of the statements of Council Actions on the 1947 recommendations may be obtained by writing to headquarters. (For a story on Council actions see page 1066 of this issue.)

Public Relations

Following a review of the secretary's suggested policy on public relations, it was agreed to ask the Meetings Committee to appoint a committee consisting of one member of its committee and four others to consider the broad program of Society public relations and to make recommendations to the Executive Committee.

Canons of Ethics

Ballot approval by the Council of the Joint Code of Ethics for Engineers was noted. The joint code was prepared by the E.C.P.D. Committee on the Principles of Engineering Ethics on which William F. Ryan is the A.S.M.E. representative.

Joint A.S.T.M.-A.S.M.E. Committee

Upon request of the Boiler Code Committee for action to improve the present method of specifying materials in the A.S.M.E. codes, it was agreed that the Society should confer with the American Society for Testing Materials

for the purpose of organizing a joint committee to study the advisability of developing a group of general materials specifications, methods of testing, and a program for the further study and development of such specifications and tests.

Committee on Gifts and Bequests

It was noted that the Committee on Gifts and Bequests, composed of A. R. Cullimore, I. E. Moultrop, and H. R. Westcott, which was authorized on Feb. 27, 1947, is proceeding with the preparation of a statement suitable for mailing to the entire membership. This statement will emphasize the importance of Society stabilization as a contribution to the future of the engineering profession.

Certificates of Award

Certificates of award were approved for the following in recognition for services on the Sections Committee: L. E. Jermy, J. A. Keeth, O. B. Lyman, Stephen D. Moxley, and A. R. Mumford.

National Security Committee

In response to an invitation from the chairman of the Citizens Emergency Committee for Universal Military Training, the secretary was authorized to arrange with other participating societies of the Engineers Joint Council to be represented informally at the organization meeting of the National Security Committee which was held October 23–24, 1947, in Washington, D. C.

William D. Ennis

The death on Oct. 14, 1947, of William D. Ennis, who served the Society as treasurer from 1935 to 1944, was noted with deep regret.

Appointments

The following appointments were approved: Alton C. Chick, as A.S.M.E. representative to the dedication of the Student Center, Northeastern University; George A. Stetson, as A.S.M.E. representative to the convocation in celebration of centennial year of Sheffield Scientific School, New Haven, Conn.

Diesel Industry to Aid Engineering Schools

ON the principle that better engineers in an industry mean better design and performance of the industry's product, the Diesel Engine Manufacturers Association was joined recently by manufacturers of Diesel-engine parts and accessories in a five-year educational program to help colleges and universities to turn out better trained engineers.

In addition to refresher courses for faculty members sponsored by members of the D.E.M.A., the industry will provide educational aids such as working models, cutaway sections, films, slides, and literature on Diesel engines and accessories. To provide liason between the educational institutions and the D.E.M.A., a full-time staff member has been assigned to visit schools and to consult with the faculty on laboratory equipment, test material, and outline of courses in Diesel engineering.

H. O. HILL

H. O. Hill New A.W.S. President

THE American Welding Society has elected Harold O. Hill, member A.S.M.E., as its president for the year 1947-1948. Mr. Hill assumed office in October at the conclusion of the 1947 annual meeting at the Hotel Sherman, Chicago, Ill.

Mr. Hill is assistant chief engineer, Bethlehem Steel Company, Bethlehem, Pa. He was born in Ontario, Canada, and educated at the University of Toronto, from which he reeeived a degree in mechanical engineering.

E. G. Grace to Receive A.I.M.E. Award

EUGENE GIFFORD GRACE, chairman of the board, Bethlehem Steel Corporation, Bethlehem, Pa., has been named to receive the Charles F. Rand Gold Medal of the American Institute of Mining and Metallurgical Engineers "for distinguished leadership in the administration of all phases of a large and complex industrial enterprise; for profound influence on the growth and health of the American iron and steel industry."

The medal will be presented at the annual meeting of the Institute in New York, N. Y., in February, 1948.

H. L. Dryden New N.A.C.A. Director of Research

HUGH L. DRYDEN, member A.S.M.E., chief of the mechanics division, National Bureau of Standards, has resigned to become director of research for the National Advisory Committee for Aeronautics, it has been announced. He will be succeeded by Walter Ramberg, member A.S.M.E.

Dr. Dryden, who has been chief of the Mechanics Division since 1934, became an Associate Director in the Bureau in 1946. His research work has centered in the general field of aerodynamics, in which he has made important contributions to the understanding of wind pressure on structures, properties of air foils at high speeds, and the nature of air turbulence.

Dr. Ramberg, who has been chief of a section in the Mechanics Division since 1946, has gained an international reputation for his work in aeronautics, particularly in the field of strength and stability of structural elements of aircraft.

Three A.S.M.E. Members Win Money Awards for Welding Papers

THREE members of The American Society of Mechanical Engineers were among the 467 winners of awards ranging from $100 for honorable mention to $13,200 for the main award announced recently by the trustees of The James F. Lincoln Arc Welding Foundation in its 1946–1947 $200,000 Design for Progress Program.

Sidney Low, Jun. A.S.M.E., research engineer, Chapman Valve Manufacturing Company, Indian Orchard, Mass., won the first Containers Classificational Award of $3200. Mr. Low is a graduate of Rensselaer Polytechnic Institute, Troy, N. Y. His paper described the development of a method of combining arc-welded stainless steels with the "Malcolmizing" process for hardening the stainless steels for corrosion-resistant facings on valve gates and seat rings.

Richard M. Nelden, Jun. A.S.M.E., research engineer, American Blower Corporation, Detroit, Mich., was the winner of the first Personal Service Machinery Classificational Award of $3200. Mr. Nelden is a graduate of the University of Utah, Salt Lake City, Utah. His paper described the design and construction of a gyrol fluid drive for boiler feed pumps and showed how the use of welding could save as much as $500 per unit in manufa ring costs.

Arnold F. Meyer, member A.S.M.E., chife engineer, The Heil Company, Milwaukee, Wis., won the third Containers Classificational Award of $1700 for his account of the design and construction of a 2500-gal aluminum motor-truck tank. Mr. Meyer is a graduate of the University of Wisconsin, Madison, Wis.

The James F. Lincoln Arc Welding Foundation was created in 1936 "to encourage and stimulate scientific interest in, and scientific study, research and education in respect of, the development of arc welding." The Foundation seeks to bring out the inherent ingenuity of the men who create American industry by offering awards for papers on arc-welded design, research, and education.

The Foundation provides funds to 250 engineering schools in the United States and abroad for the purchase of scientific books on welded design and applications.

As a result of the 1946–1947 program, the Foundation expects to publish a number of books, the chief of which will be called "Design for Welding." This book will be released early in 1948.

American Support Aids World Engineering Conference

First Year Progress Reviewed at Zurich

A WORLD federation of engineering organizations was one step nearer realization because of the support of the engineers of 21 nations who sent 50 delegates and observers to the second meeting of the Council of the World Engineering Conference held at the Palais du Congress, Zurich, Switzerland, Sept. 10 and 11, 1947.

Stewart E. Reimel, member A.S.M.E., and secretary of the Engineers Joint Council Committee on International Relations, attended the meetings as United States representative. The American Society of Civil Engineers, The American Society of Mechanical Engineers, and the American Institute of Chemical Engineers are sponsoring the United States National Commission to World Engineering Congress and plan to invite some 50 other American engineering agencies to participate in W.E.C. program.

Organized in September, 1946, by delegates in attendance at the First International Technical Congress in Paris, France, the W.E.C. is an interim agency working for eventual federation of the world engineering profession. In addition to the nine nations, including the United States, who signed the Paris minutes, five other nations have joined the W.E.C. during the first year of its existence. Member nations are: Belgium, Egypt, United States, France, Great Britain, Hungary, Iran, Italy, Netherlands, Philippines, Poland, Rumania, Switzerland, and Czechoslovakia. Five other nations, China, Syria, Luxembourg, Bulgaria, and Yugoslavia, have indicated that they are forming national committees and will become members shortly. Mexico, Brazil, Argentina, and other South American nations are also considering membership. Russia has been approached but no word had been received from the Association of Engineers in Moscow.

At the meeting of the W.E.C. Executive Board which preceded the Council meeting, a proposal was made to change the name of the organization because the word "conference" was causing confusion in the English-speaking countries. The Board decided, however, to continue the present name until the body is transformed into the International Federation.

Fenton B. Turck Elected Vice-President

Aristide Antoine and Rene Picard were reelected president and general secretary, respectively. Fenton B. Turck, member A.S.M.E., was elected as vice-president. The following countries were named to serve on the Executive Board for 1948: Belgium, Egypt, United States, France, Great Britain, Poland, Switzerland, and Czechslovakia.

Detailed reports covering the activities of national committees of the 14 member nations was the Council's first order of business. The observers from Holland and Denmark said that engineers in their countries were waiting for a clearer definition of W.E.C. objectives before organizing national committees.

Following these reports, the delegates exchanged views on the objectives of the W.E.C. It was agreed that an important part of the W.E.C. program should be the encouragement of international exchange of engineers. The executive board was charged to establish a practical program to promote such an exchange.

In connection with the documentation of technical literature discussed by the delegates, Mr. Reimel called attention to The Engineering Index sponsored by the Founder Societies of the U. S. A. This American enterprise was unknown to the delegates present who requested that literature on it be furnished W.E.C. headquarters in Paris.

W.E.C. Publication Suggested

Publication by the W.E.C. of an International Technical publication similar to a publication which now serves the field of medicine, was proposed by the Hungary Delegation. As the Council of Scientific Union is currently working on such a publication, it was decided to study the proposal to avoid duplication of the work of other international bodies.

In the discussion of the W.E.C. project to publish an international yearbook of engineering associations, Dr. Frank Malina, observer for UNESCO, reported that his organization was interested in this project, and was to allot $2000 to W.E.C. for this work. Mr. Reimel told the delegates that the A.S.M.E. was to publish in December under sponsorship of the Engineers Joint Council, a yearbook of American engineering organizations and that the W.E.C. was welcome to the information available and to the questionnaires used in this compilation.

General interest was shown in W.E.C. bulletin published by the British national committee for its members. As a result of the discussion, the W.E.C. Executive Board will study the British bulletin and give consideration to the possibility of a General Bulletin of the W.E.C.

Upon suggestion of the British delegation a special committee of the Executive Board will appoint a committee of six to eight members to study the social and internaticnal implications of technological advances.

An International Technical Prize proposed at the 1946 Congress, was discussed, but this project was deferred to a later date.

1949 Congress Set for Cairo

S. E. Hassein Said Bey, president of the Egyptian National Committee, invited the Conference to hold the International Technical Congress in Cairo in March, 1949. This invitation was accepted on behalf of the delegates by Aristide Antoine, president, W.E.C. General themes for the next congress were developed by the Delegates. These are to be problems of a general technical nature, problems of a professional and social nature, and problems relating to the general Nile region.

Applied Mechanics Congress to Be Held in London Sept. 5–11, 1948

AN invitation has been extended to American engineers and scientists to attend the Seventh International Congress of Applied Mechanics to be held at the Imperial College of Science and Technology, South Kensington, London, England, Sept. 5–11, 1948.

Tentative plans call for a sherry party on Sunday, Sept. 5, in the college buildings, at which the College will be host. An informal dance to be organized by the students for Wednesday, Sept. 8, is also planned. The Congress dinner on Friday, Sept. 10, will be the final social function of the Congress.

The technical sessions will be organized under the following sections: (1) elasticity and plasticity; (2) aerodynamics, hydrodynamics, meteorology; (3) thermodynamics, heat transfer, etc.; and (4) vibrations, lubrication, and experimental methods. In addition, as many as ten general lectures or surveys are contemplated on subjects likely to be of interest to members.

Members whose papers are accepted for presentation should provide copies of abstracts for the information of other members. These should be in the hands of the organizing secretary of the Congress as early as possible. The Imperial College has no facilities for reproduction of abstracts of papers.

The registration of approximately $5 may be paid at time of registration or in advance to the organizing secretary at Imperial College.

Members are strongly advised to use traveler's checks rather than letters of credit because these are more easily negotiable. Arrangements are being made for cashing traveler's checks within the College during the period of the Congress.

During the week following the Congress inspection trips are being planned to the National Physical Laboratory, the Royal Aircraft Establishment, the National Gas Turbine Establishment, and the General Electric Research Laboratories.

The Organizing Committee of the Congress is compiling a list of hotels in the neighborhood of the College. Engineers planning to attend the Congress are urged to get in touch with the Organizing Committee as soon as possible. For the best hotel accommodations reservations should be made early in 1948. These can be made through the Organizing Secretary at Imperial College.

UNESCO Panel Develops Science Programs

ABOLITION of secrecy in scientific affairs and promotion of popular understanding of science and its social implications were among a number of resolutions endorsed by a panel of experts who met at the Museum of Natural History, New York, N. Y., Oct. 30 and 31, 1947, to draft suggestions for the 1948 program of UNESCO (United Nations Educational, Scientific, and Cultural Organization).

American engineers were represented on the panel by Fenton B. Turck, member A.S.M.E., and president of the consulting firm of Turck, Hill and Co. Inc., New York, N. Y. Mr. Turck is a member of the E.J.C. Committee on International Relations and a vice-president of the World Engineering Conference. Other members of the panel were science representatives of the press, radio, education, industry, Government, and UNESCO.

The panel discussed ways in which UNESCO could stimulate the co-ordination of existing national agencies already active popularizing science, form such agencies in countries which do not have them, as well as how to stimulate interpretations of the international and social implications of science.

An immediate program for greater use of the press, radio, moving pictures, adult education, and interchange of students and professors was discussed at length. The spread of science clubs and science fairs was encouraged.

The recommendations of the New York meeting and a similar one in Paris held early in October formed the agenda of the General Conference of UNESCO held in Mexico City early in November.

A.S.M.E. Member's Safety Ideas Circulated by Navy Bureau

A "Briefing the Record" article on personal flying published on page 864 of the October issue of MECHANICAL ENGINEERING was the subject of a memorandum addressed to the personnel of the Ships Division, Bureau of Ships, Washington, D. C., by Rear Admiral C. L. Brand, U. S. Navy, assistant chief of the Bureau.

The article, which was an abstract of a talk given by Jerome Lederer, member A.S.M.E., at a symposium of the Institute of Aeronautical Sciences in Detroit, Mich., presented a basic philosophy for designers of private aircraft.

In his memorandum Admiral Brand said that Mr. Lederer's ideas on design for safety are equally applicable to the design of ships and that the application of them may help to "create better and safer ships for normal engineering ratings."

Mr. Lederer is chief engineer of the Aero Insurance Underwriters, New York, N. Y.

Monthly Review of World Literature in Applied Mechanics to Be Published by the A.S.M.E.

A CRITICAL review of current world literature in applied mechanics will be inaugurated in January, 1948, in the form of a monthly to be called *Applied Mechanics Reviews*.

Applied Mechanics Reviews, which will be published in the English language, is to be offered on a subscription basis. It will contain comprehensive reviews of new theories, methods, data, and calculations having general application in the field of applied mechanics as they currently appear in 300 of the world's leading scientific and engineering journals.

The new publication is planned as a nonprofit co-operative project and will engage the services of eminent engineers and scientists, who will act as reviewers in all parts of the world. Seven national scientific and professional agencies in the United States and several outside will guide its editorial policies and have appointed representatives on an Advisory Board. At present The Institution of Mechanical Engineers and The Engineering Institute of Canada are co-operating in launching the new publication and will appoint advisory representatives. The *Reviews* will be published by The American Society of Mechanical Engineers with the support of the Engineering Foundation, and the Illinois Institute of Technology. Business management of the magazine has been assumed by a Managing Committee of The American Society of Mechanical Engineers. Space for editorial offices has been provided by the Illinois Institute of Technology.

Members of the Managing Committee are: G. B. Pegram, chairman, dean of the Graduate School of Science, Columbia University, New York, N. Y.; Hugh L. Dryden, director of aeronautical research, National Advisory Committee for Aeronautics, Washington, D.C.; J. S. Thompson, chairman of the board, McGraw Hill Book Company, Inc., New York, N. Y., and the chairman of the A.S.M.E. Applied Mechanics Division.

Seven Agencies Participate

Members of the Advisory Committee are: R. E. Peterson, chairman, The American Society of Mechanical Engineers; Mark K. Markovin, Office of Naval Research; R. D. Mindlin, secretary, Society for Experimental Stress Analysis; G. R. Rich, American Society of Civil Engineers; F. V. Hunt, American Institute of Physics; J. L. Synge, American Mathematical Society; and K. S. M. Davidson, Institute of the Aeronautical Sciences.

L. H. Donnell, internationally known scientist, has been appointed editor in chief of *Applied Mechanics Reviews*. Dr. Donnell, who is professor of mechanics at the Illinois Institute of Technology, will devote full time to the new magazine until the venture is well launched. Dr. Stephen Timoshenko, recognized all over the world as dean of applied-mechanics studies, will serve as editorial adviser.

As a monthly review of world literature in applied mechanics, the new magazine will provide a useful tool for the research worker in industry, university, and government laboratories, as well as engineers and teachers practicing in the field of mechanics. It will make available brief authoritative reviews contributed on a voluntary basis by engineers and scientists recognized as specialists in their field. For the research worker, *Applied Mechanics Reviews* provides a monthly compendium of the work of his colleagues in the research centers of the world. For the engineer and teacher it provides a ready source of the new ideas published in their field.

200 Reviews Each Month

During the first year, monthly issues of 40 pages to contain about 200 reviews each are planned. The individual reviews, which will be signed, will be grouped into sections to enable readers to select reviews of special interest to them. These sections will cover such subjects as: General theoretical and experimental methods; elasticity theory; experimental stress analysis; rods, beams, tubes, and cables; plates, disks, shells, and membranes; buckling problems; welds, rivets, and other joints; general and aeronautical structures; plastic flow and forming processes; laws of failure; cutting processes; material test techniques; properties of special materials; soil mechanics; vibration and impact; vibration isolation and measurement; acoustics; flutter; kinematics, statics, and general dynamics; gyroscopes, balancing, and governors; aerodynamics of flight; exterior ballistics; potential flow, turbulence and boundary layer; compressible flow and gas dynamics; propellers, fans, and turbines; experimental flow equipment and techniques; lubrication problems; hydraulics and flow in pipes; meteorological dynamics, wind velocity, and tides; marine-engineering problems; heat transfer and thermodynamics,

Each review will contain bibliographical references to original source and language and author and will be signed by the reviewer. A photostat service is available for persons who wish copies of articles reviewed. The new magazine will limit its editorial content to reviews of 500 words or less depending on the significance attached to the original paper by the reviewer. Illustrations and mathematical demonstrations will be published only when they are necessary to an understanding of the review.

Applied Mechanics Reviews will re-establish the service formerly provided by the German review publications on a vastly improved basis. The editorial board of the new magazine will cull the monthly output of more than 500 engineering and scientific journals. Significant articles will be selected and assigned to co-operating reviewers, specialists in the industrial and university research centers of the world. The qualification of these reviewers will be eminence in some division of mechanics and a willingness to devote time to service of fellow scientists. Reviews written in languages other than English will be translated into English by the editorial staff and published in that language. All reviews will credit reviewers who will take full responsibility for them.

The business address of the new publication to which subscriptions should be addressed is Applied Mechanics Reviews, 29 West 39th Street, New York 18, N. Y. Address of the editorial office is Illinois Institute of Technology, Chicago 16, Ill.

A.S.M.E. Junior Forum

COMPILED AND EDITED BY A COMMITTEE OF JUNIOR MEMBERS, C. H. CARMAN, JR., CHAIRMAN

The Ball Hits a Bump

PESSIMISTIC is the word for the editors of the *Junior Forum*. For two months they have wandered in a wilderness searching the landmarks which would point the way to an editorial policy acceptable to junior members of the Society. These landmarks were to be the comments from juniors telling what they want and expect from the *Junior Forum*. But the editors have found no landmarks and the witches of doubt have been howling over the editorial campfires.

Maybe junior members are in fact sound asleep dreaming the dreams of campus days. Maybe "the whoop and the holler" about the problems of the young engineer, which planted the idea of the *Junior Forum* is but the noise of a few misguided voices. Maybe junior members have not yet penetrated the professional level of thinking.

Of course these are foolish suspicions but they fill the vacuum created by the absence of fact to dispel them. The editors recently sat around a bare table and asked two disturbing questions: What do juniors want? What do they think of the *Junior Forum*?

The silence was oppressive because these questions were asked of eight chairman of A.S.M.E. Junior Groups and of 40 junior members who joined the Society in 1946. These recent junior members were spotted in many industries and in all regions of the Society. A few replies were received but the vast majority remained silent. Speculating on absence of comments, the editors decided reluctantly that either junior members have no interest in the *Junior Forum* or they are too busy to express themselves on professional problems.

At this stage of the *Junior Forum* the editors need constructive comment. Give them the value of your opinion so that they can mold these pages into a useful instrument of Society service.

MEMBERS OF THE A.S.M.E. JUNIOR COMMITTEE

(*Left to right:* H. C. Thuerk, member A.S.M.E., president, New Jersey Light and Power Company, Dover, N. J.; Philip Allen, Jun. A.S.M.E., test laboratory, U. S. Naval Base, Philadelphia, Pa.; Donald E. Jahncke, Jun. A.S.M.E., Plymouth Division, Chrysler Corporation, Detroit, Mich., chairman; Charles H. Carman, Jr., Jun. A.S.M.E., Elliott Company, New York, N. Y.; George B. Thom, member A.S.M.E., director of training, Sun Shipbuilding and Drydock Company, Chester, Pa.)

Letters

Good but Stuffy

To the Editors:

CONGRATULATIONS! The birth of the A.S.M.E. *Junior Forum* is a very pleasant and welcome surprise for us neophytes (more commonly known as junior members)! The "forgotten man" comes into his own! Let's hope we can make the most of it.

Your explanation of the purpose of the *Junior Forum*, and the ideas discussed were very pertinent and to the point. We hope they will have a good reception throughout the mechanical-engineering world. However, there is one thing I am wondering about: Will the response from junior members be as great as expected? Will they be read by a percentage of our group? In other words, will the *Junior Forum* be noticed at all, or will it be just another article hidden in a myriad of fine print and conservative format?

I would like to suggest that we be proud of our new baby. Let's dress it up! Let's make people sit up and take notice! Let's give it some life! We all know that a lecture on a most interesting subject can be either a dud or a hit depending entirely on the presentation. Shirley Temple would not have been a star without a curl or a smile!

I am satisfied with the intent and subject matter discussed in the first *Junior Forum*, but I would like to see it presented in a much less conservative manner. How about a more outstanding heading for the page, larger type, and improved arrangement of the articles on the page?

Do you think I am asking for too much?

ROY W. VORHEES, JR.[1]

Professional Development

To the Editors:

I READ with great interest that the Engineers' Council for Professional Development had just commemorated its fifteenth anniversary. I am particularly interested in the future plans of this "Conference body" for the junior engineer. They have been very successful in the accrediting of engineering curricula and in the program for student selection and guidance. Their next major problem, in my opinion, is to develop plans to aid the junior engineer to become professionally mature.

When the young engineer was a student he was guided toward a specific goal. His curriculum had been laid out for him, his technical society had been organized for him, and his deportment as an engineer had been prescribed by his faculty advisers. When he leaves the halls of learning and enters the business world, there is a void in the process of making him a professional man. More often than not, he must leave the locale of his engineering education. His fellow students have gone their own way and so his only contact with his known engineering world is gone. This is really the state of mind in which most junior engineers start their professional life. Is it any wonder that these men need guidance from the older members of the engineering societies?

A definite plan should be prepared whereby each graduate engineer can continue his association with the engineering societies. By

[1] Jun. A.S.M.E., Plymouth Motor Company, Division of Chrysler Corporation, Detroit, Mich.

this, I mean to send to each graduate student member information regarding the local section to which he should belong. Give his name to the local chairman so that he can be invited to their meetings. More than once I have heard a junior member profess interest in a society meeting for the first time after he had been invited by an active member.

It has been my observation that the average junior engineer wants to develop professionally. One of the major steps toward this goal is the attainment of legal recognition. The E.C.P.D. should aid the engineer to obtain his license and should try to make it financially wise for him to do so. I firmly believe that the future barrier between a professional man and a nonprofessional man in engineering will be determined by the professional engineers' license. There is a great deal of agitation in recognized engineering firms by union organizers. Catch-all unions have been formed to include technical men, draftsmen, architects, engineers, etc. If the engineers would use the professional engineer's license as their sole identification badge, then only would their professional status be recognized. The E.C.P.D. should embark on a program to help the junior engineer to keep his true identity in industry.

Employers Can Help

I have a final suggestion to give to the Engineers Council for Professional Development. I would like to see this Council petition industry for an adoption of a program whereby the junior engineers in their organizations would be permitted to attend the sectional meetings of the Society. The education and experience obtained by these junior engineers would repay their employers a hundredfold for any expense or inconvenience entailed by such a program. Help the young men in industry to attend their society technical meetings. Arouse in them a desire to participate in their profession by keeping them informed of the advancements in technical information. Provide a supervised expense for these men so that they will be financially able to attend. If something concrete like this is done, you will have incited in these men a pride in their profession, a responsibility to their employers, and a faith in themselves as engineers.

ARTHUR J. HUGHES.[2]

Valuable Link

To the Editors:

I WAS pleased to receive your inquiry requesting my opinion of the current Society plan for its junior members. I enjoyed very much the *Junior Forum* in the October MECHANICAL ENGINEERING. And I definitely agree that this project will survive only if the junior members of the Society contribute actively with opinions on current engineering topics. I do not, however, advocate the *Forum* becoming a "gripe" sheet, unless such criticism is at least accompanied by suggested constructive changes.

Being employed as a junior engineer, engaged in technical writing at the Gates Rubber Company, I feel keenly your desire for reports and opinions on current problems. And, incidentally, I tend to agree with[3] Mr. Purcell in his attitude on engineers and unions. For a completely autonomous group, unions might be helpful, but to be swallowed into a larger group, one probably lacking all but the minutest interest in the welfare of the engineer, would not be any gain for the young professional man. Improvement in status can come through collective action, perhaps even professional unionization, but not through affiliation with any group which does not have the vital problems of the engineer at heart.

I value my membership in the Society considerably and expect to increase this appreciation in the years to come. Quite likely, we here in the western part of the country, particularly those of us who do little traveling, do not share as actively in the Society as do many of the eastern members, but MECHANICAL ENGINEERING forms a valuable link for all of us. My one thought of criticism concerns the Divisions in which I am registered. I would appreciate knowing what is happening in these Divisions, other than just receiving notices of meetings to be held. Again, for those of us who are generally unable to attend these meetings, abstracts of the important papers and speeches at these meetings would certainly be appreciated and would make us feel that the Society is of even more worth to us. It has been stated that a great deal of the value of A.S.M.E. to us young engineers is intangible; perhaps so, but to us who have grown up in a very realistic world, a bit more of the tangible value would be appreciated.

EDWIN J. BUSCH.[4]

Learning to Crawl

To the Editors:

I AM in receipt of your letter of October 20th for which I thank you very much and I want to tell you why I appreciate it. It was the first time that I have felt that I was even close to the association of this Society.

Upon receiving my degree in mechanical engineering from the University of Oklahoma in February, 1946, I immediately went to the Armed Forces. After receiving my discharge this spring, I have moved to Dallas and am employed by the Browning-Ferris Machinery Company in sales engineering work. Now I realize that this is somewhat different than many jobs for engineers but I would like very much to keep in close contact with the Society and do what I can to help in this organization.

I think the Society is the best means of informing graduate engineers on progress in the field as well as a wonderful opportunity for the graduate engineer to come in contact with the most prominent senior engineers in the country. I value my membership not because being a member will engrave my name in gold but because it does give me a wonderful opportunity to enlarge my education in the engineering field, and the graduate engineer has so much to learn. I realize that you get out of anything only what you put into it and since becoming a junior member, I have not had the chance to put into it what I would like to.

Since going into the field, I have found that so many concerns expect the graduate engineer to have field experience and everyone knows that you have to "crawl" first. That is one thing that often discourages the young engineer. Therefore I feel that if some arrangements can be made whereby the junior members of the Society can play a larger part and with the aid of the senior members they may be able to strengthen themselves in learning to "crawl." If this idea were exercised enough it could possibly mean success to many young engineers who are now stumbling in the dark.

My viewpoint is one in thousands and I understand that you have many viewpoints to contend with, but if there is anything that I may do to help pitch in and better all junior members, I am willing to do anything I possibly can.

W. M. SPOTTS.[6]

[2] Jun. A.S.M.E., Babcock and Wilcox Company, New York, N. Y.

[3] Unionization of Engineers—Yes or No? by T. E. Purcell, vice-president elect, A.S.M.E. Region V, General Superintendent of Power Stations, Duquesne Power Company, Pittsburgh, Pa., published in the October, 1947, issue of MECHANICAL ENGINEERING on pages 877 and 878.

[4] Jun. A.S.M.E., Gates Rubber Company, Denver, Colo.

[6] Jun. A.S.M.E., Browning-Ferris Machinery Company, Dallas, Texas.

News Notes

Faith of the Engineer

THE public is generally familiar with the "creed" of medical doctors, the Florence Nightingale pledge of nurses, and other similar idealistic tributes to the aims and principles of professional organizations and groups. Engineers, however, have long been without any such declaration of the precepts which guide them in their professional activity. This situation has been corrected with the publication and issuance of the "Faith of the Engineer" by the Engineers Council for Professional Development which declares for all to read:

E.C.P.D. Creed

"I am an Engineer. In my profession I take deep pride, but without vainglory; to it I owe solemn obligations that I am eager to fulfill.

"As an Engineer, I will participate in none but honest enterprise. To him that has engaged my services, as employer or client, I will give the utmost of performance and fidelity.

"When needed, my skill and knowledge shall be given without reservation for the public good. From special capacity springs the obligation to use it well in the service of humanity; and I accept the challenge that this implies.

"Jealous of the high repute of my calling, I will strive to protect the interests and the good name of any engineer that I know to be deserving; but I will not shrink, should duty dictate, from disclosing the truth regarding anyone that, by unscrupulous act, has shown himself unworthy of the profession.

"Since the Age of Stone, human progress has been conditioned by the genius of my professional forebears. By them have been rendered usable to mankind Nature's vast resources of material and energy. By them have been vitalized and turned to practical account the principles of science and the revelations of technology. Except for this heritage of accumulated experience, my efforts would be feeble. I dedicate myself to the dissemination of engineering knowledge, and, especially to the instruction of younger members of my profession in all its arts and traditions.

"To my fellows I pledge, in the same full measure I ask of them, integrity and fair dealing, tolerance and respect, and devotion to the standards and the dignity of our profession; with the consciousness, always, that our special expertness carries with it the obligation to serve humanity with complete sincerity."

The E.C.P.D. has printed this creed in an attractive black and red layout on high-quality white paper suitable for framing. Two sizes are available for purchase from the E.C.P.D., 29 West 39th Street, New York, 18, N. Y. A $15\frac{1}{2} \times 22$-in. size sells for $3 and an $8\frac{1}{2} \times 11$-in. size for $0.50. All juniors are urged to take advantage of this offer and to make a practice of displaying this creed wherever they are at work. By such display the junior will be furthering the efforts to enhance the public recognition and esteem of the engineering profession as well as indicating to his associates and co-workers the principles by which he works.

Metropolitan Juniors Embark on Ambitious Program

THE Junior Group of the A.S.M.E. Metropolitan Section has embarked on a five-point program founded on the belief that help in professional matters will come to those who first make an attempt to help themselves.

As a result of the spirited prosecution of its program last year which resulted in a complete plan for the organization of the engineering profession designed to advance engineers economically, the Junior Group not only won the admiration of Metropolitan Section officers but created a sound working organization eager to direct its attention to other problems.

This group has been co-ordinated with a committee of the Section as the Joint Committee on the Status of the Engineer. Under the chairmanship of Morton H. Staub, Jun. A.S.M.E., this committee, composed of five juniors and two members of the Metropolitan Section Executive Committee, has chosen "The Civic Responsibility of the Engineer" as the theme for their 1947–1948 program. Five subcommittees composed entirely of juniors are now at work onthe following tasks:

(1) Development of a Plan. This subcommittee is headed by Thomas P. Farkas, Jun. A.S.M.E., Bell Telephone Laboratories, Inc., New York, N. Y. Its task is to review the work done last year, to incorporate new information developed during the year, and to present a modified plan for the economic betterment of engineers.

(2) Education of the Young Engineer. Headed by Donald L. Greaves, Jun. A.S.M.E., Ebasco Services, Inc., New York, N. Y., this group is working on a plan suggested by A. R. Mumford, vice-president, A.S.M.E. Region II, which aims at inaugurating a series of lectures covering the main field of mechanical engineering. The lectures to be given by specialists will bring to juniors and students an awareness of the potentialities of the particular field in which they are working.

(3) Educating the Undergraduate. This group under Burton H. Edlestien, Jun. A.S.M.E., Graham Manufacturing Company, New York, N. Y., is working closely with the group studying the education of the young engineer but is directing its attention of the undergraduate, the ethics of the profession, job opportunities, and facts of the profession usually learned after graduation.

(4) Survey of Management's Viewpoint. This group hopes to define management's viewpoint of the young engineer by meeting with a committee representing management for a discussion of topics of interest to the junior member.

(5) Laws Regulating Engineering Profession. This subcommittee under the chairmanship of Henry E. Cook, Jun. A.S.M.E., Brooklyn, N. Y., is at work analyzing statutes and regulations affecting junior engineers. They expect to submit recommendations which may help the Society to improve the status of engineers.

While this is a program of no mean proportions, the Metropolitan Junior Group has already cut its teeth on a major project. It has an enthusiastic working group of junior members. Under the guidance of the Executive Committee of the Section, it hopes to achieve its goals.

Junior members in other A.S.M.E. Sections are invited to participate in its program. For more information, write to John H. Prentiss, 55 West 42nd St., Room 1240, New York 18, N. Y.

Junior Group Manual

At the last meeting of the National Junior Committee, the new manual or guidebook telling how to organize new groups was discussed at some length. It appears that it is now in its final form and should be ready for distribution soon. They plan to send it to all junior members, so be on the lookout for it. This manual, in addition to explaining organization technique, will suggest programs which have proved to be of interest to engineers.

Now is the time to reorganize junior activities in the Sections and to revive junior organizations which were victims of the war. In 1939 more than 30 A.S.M.E. Junior Groups were active. Today the number is less than 10. The new manual is loaded with ideas for juniors who are eager to participate in Society affairs. When you receive the manual, the next move will be up to you.

Atlantic City

Due to the time element, it is not possible to report on the get-together meeting at Atlantic City. In the next issue, however, the editors will report a complete story, telling what plans were discussed as well as comments in general.

Annual G. E. Fellowships Announced

AID to college and university graduates who wish to undertake or continue research work in scientific and industrial fields was announced recently by the General Electric Company, Schenectady, N. Y., for the 24th consecutive year.

Applications now are being accepted for the scholastic year 1948–1949 for grants under the $1,000,000 G. E. Educational Fund, from the income of which the fellowships are awarded.

Individual fellowships will be for the amount needed up to a maximum of $1500 annually for each individual. A grant of $500 may be made for specific apparatus or other expense in connection with the research work. In addition, in case of need, loans up to $1000 may also be made.

Fellowships are intended for graduates who need financial assistance, and who have shown by the character of their work that they could with advantage undertake or continue research work in educational institutions either in this country or abroad. They are not intended for graduates who now hold, or expect to hold, any other fellowship which carries a stipend larger than the tuition at the institution where the research work is to be done.

Applications, which may be obtained from A. D. Marshall, secretary, General Electric Educational Fund, Schenectady, N. Y., will be passed on by a committee representing the National Academy of Sciences, American Chemical Society, American Physical Society, American Institute of Electrical Engineers, The American Society of Mechanical Engineers, and the American Society for Engineering Education.

W. E. Pratt to Receive Lucas Gold Medal

WALLACE E. PRATT, former vice-president of the Standard Oil Company of New Jersey, has been awarded the Anthony F. Lucas Petroleum Gold Medal of the American Institute of Mining and Metallurgical Engineers for distinguished achievement in improving the technique and practice of finding and producing petroleum.

The award will be presented to Mr. Pratt at the annual meeting of the Institute in New York, N. Y. in February, 1948.

Standard Safety Self-Appraisal Form for Use of Industrial Plants Published by A.S.M.E.

A FORM with explanatory notes for self-appraisal of safety provisions of industrial plants was published in November by The American Society of Mechanical Engineers.

The form places in the hands of management a useful tool for measuring the progress of individual plants toward the minimum safety standards recommended by the safety codes of the American Standards Association and The American Society of Mechanical Engineers and for comparing the safety rating of different plants.

The first official draft of the form called "A.S.M.E. Standard Form for Use in Self-Appraisal of Industrial Plants," is a 44-page booklet $5^1/_4 \times 7^3/_4$ in. in size and is the result of many years of work by members of the A.S.M.E. Safety Committee.

As important factors on the problem of accident control, the form gives recognition to safe planning, construction, safeguarding of equipment, housekeeping, safe storage, materials handling, supervision, education, and safety rules and their enforcement, together with management leadership and participation in a safety program.

The booklet presents a method for determining the safety rating of an industrial plant on a percentage basis after evaluating in detail the accident hazards introduced in its operations, the accident-prevention devices it employs, and the accident-prevention techniques employed by its management.

How the Scheme Works

This is how the new A.S.M.E. safety self-appraisal scheme works. A maximum numerical credit is assigned to each plant condition which breeds accidents and to every countermeasure which prevents accidents.

If conditions in an industrial plant are in accordance with the minimum requirements suggested by accepted standard safety codes, the plant claims 1000 credits and its safety rating is 100 per cent. Since all minimum safety requirements are often not satisfied in any particular plant, the form lists and assigns a maximum credit to each accident hazard and provides a method of calculating a claimed credit value which compares actual safety conditions with the minimum requirements of the codes. The summation of the claimed credits shows a number of credits less than 1000 and therefore a safety rating for the plant of less than 100 per cent.

Serves as Measuring Stick

The virtue of the new A.S.M.E. standard safety appraisal form is that, for the first time, the safety ratings of different plants can be compared on an equitable basis. It gives management a measuring stick by which it can determine how closely its plants meet the minimum requirements established by the accepted safety codes. In addition, it provides a basis for judging the effectiveness of management's policy by indicating how the safety rating of any one plant progresses or retrogresses in the interval between appraisals.

Safety Authorities Contribute

The need for a uniform method of safety self-appraisal for industry was first suggested by Theodore F. Hatch, member A.S.M.E., Industrial Hygiene Foundation, Pittsburgh, Pa., at a meeting of the A.S.M.E. Safety Committee in 1939. The following year three different drafts were submitted for consideration to a special subcommittee under the chairmanship of Mr. Hatch. Work on the plan was brought to a standstill as the war progressed and personnel of the committee were called to war-emergency work. In 1943, however, J. J. Zeitner, member A.S.M.E., supervising engineer, The Ocean Accident and Guarantee Corporation, Ltd., New York, N. Y., and H. W. Gabor, member A.S.M.E., principal safety supervisor, The New York State Insurance Fund, New York, N. Y., undertook to revive and complete the project. The draft as published includes suggestions from insurance-company executives, governmental departments, and industrial executives.

Use by Industry Sought

In making the first official draft of the form available to industry, the A.S.M.E. Safety Committee hopes that the form will be given a thorough trial by plant managers and inspection agencies. Constructive criticism of the form can lead to a uniform method of safety self-appraisal and provide a needed impetus to accident prevention on a national scale.

Copies of the self-appraisal form may be ordered from Publications Sales, A.S.M.E. Headquarters, 29 West 39th Street, New York 18, N. Y., at 75 cents per copy.

Welded Unflanged Heads for Pressure Vessels to Be Investigated

TO KEEP the Boiler Construction Code of The American Society of Mechanical Engineers abreast of technological developments, the A.S.M.E. Boiler Code Committee outlined recently a procedure for a test program involving the use of welded unflanged heads for pressure-vessel designs in which heads receive some support from braces, tubes, or other structural details.

If exploratory tests to be made by the Combustion Company, New York, N. Y., justify further expenditure of money, engineering models may be built using proposed construction. These models would then be subjected to exhaustive tests simulating operating conditions.

The new project was encouraged by the success of the investigation into the use of welded staybolts for power boilers which resulted in the revision of the Code in 1946 permitting the use of the welded staybolts in certain types of construction.

General support of the project was given by 38 representatives of the pressure-vessel industry who attended a dinner and public hearing sponsored by the A.S.M.E. Boiler Code Committee at the Engineers' Club, New York, N. Y., Oct. 16, 1947. Engineers representing the interests of manufacturers, inspection agencies, and state inspection officials, agreed upon a preliminary plan for testing the proposed flathead construction.

Dan L. Royer, chairman, subgroup on Fire-Tube Boilers of the Subcommittee on Power Boilers, and H. E. Aldrich, chairman, Subcommittee on Power Boilers, presided at the hearing.

Safety Engineers Form Independent Unit

THE American Society of Safety Engineers became an independent organization by action of its membership at an annual meeting in Chicago, Ill., Oct. 7, 1947. The National Safety Council, of which the society has been an engineering section for 23 years, will continue its financial support. Headquarters of the A.S.S.E. will remain in Chicago, Ill.

John S. Shaw, director of safety, Hercules Powder Company, Wilmington, Del., was elected president of the new organization.

Other officers elected are: first vice-president, R. H. Ferguson, Republic Steel Company, Cleveland, Ohio; second vice-president, E. C. McFadden, Texas Employers Insurance Association, Dallas, Texas: executive secretary, A. D. Caddell, American Society of Safety Engineers, Chicago, Ill.; treasurer, Ernest S. Beaumont, The Peoples Gas Light and Coke Company, Chicago, Ill.

A.S.M.E. Sessions Planned at Materials-Handling Conference

THE Materials Handling and Management Divisions of The American Society of Mechanical Engineers will participate in the conference on Materials Handling to be held at the Public Auditorium, Cleveland, Ohio, Jan. 13 and 14, 1948, it was announced recently by Curtis H. Barker, Jr., member A.S.M.E., and secretary A.S.M.E. Materials Handling Division.

The conference will be held concurrently with the National Materials-Handling Exposition which is also planned for the Public Auditorium in Cleveland, Ohio, Jan. 12 to 16, 1948.

A.S.M.E. sessions will be held on Wednesday, Jan. 14. In addition to attendance at the exposition, A.S.M.E. members will go on inspection tours of plants in the Cleveland area which have solved materials handling by use of special methods.

D. K. Wright, Jr., Jun. A.S.M.E., of the Case Institute of Technology, and E. R. McCarthy, associate A.S.M.E., chairman and secretary-treasurer, respectively, of the A.S.M.E. Cleveland Section, are in charge of arrangements in that city. Members will make their headquarters at the Hotel Statler.

Sections

E. T. Weir Discusses Steel Industry at Meeting of Detroit Engineers

ERNEST T. WEIR, chairman of the National Steel Corporation, Pittsburgh, Pa., discussed the steel industry's current program to relieve steel shortages and national and international economic conditions in an address at a joint meeting of The Engineering Society of Detroit and the Detroit Section of The American Society of Mechanical Engineers in Rackham Educational Memorial Auditorium, Oct. 22, 1947. More than 1000 engineers were present.

Mr. Weir told the engineers that:

Although the steel industry is accused of holding down production and of failing to expand capacity, the facts are that 1947 will be the biggest year of peacetime steel production and the industry is now carrying on the greatest expansion program in its history at a cost of more than $1,000,000,000.

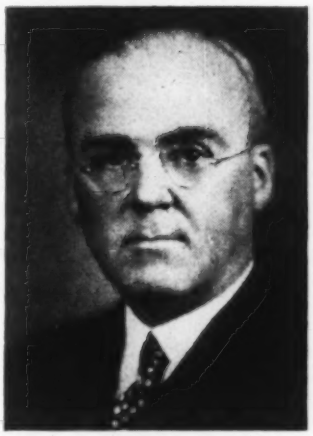
Higher prices were inevitable after the war but that government is chiefly responsible for the present price level, which is higher than necessary. He said the principal actions of government which have made prices higher were the forcing of wage rises which increased production costs, "the extravagant price tag which government places on its own services," and waste and inefficiency in government spending.

Aside from direct relief to fight hunger and cold during the coming winter, the United States should follow a "go slow" policy on foreign aid. European countries are not doing enough to help themselves. The United States should grant funds for aid only on the basis of the most thorough investigation, and total aid should be held well within the practical limits of this country's resources and ability.

The steel industry is now under heavy fire, Mr. Weir said, because it cannot supply every ton of steel that is asked for. The heavy demand, he stated, is caused by the fact that the world now depends on the United States for more than half of its steel compared with 38 per cent before the war. In the United States, he said, there is a double demand which is caused by the attempts of consumers to fill the floodtide of needs that accumulated during the war and the attempts of steel-consuming industries to build inventories at the same time that they are turning out the greatest volume of products in their experience.

Mr. Weir pointed out that the demand for inventory building "is entirely abnormal and will disappear as soon as the pipe lines are filled. This has happened already with some steel products."

The steel industry is not producing the maximum tonnage for which it has capacity because of a shortage in raw materials, principally iron and steel scrap. The scrap shortage, he said, may be attributed to the heavy



ERNEST T. WEIR

export of scrap through the 1930's up to the very eve of the war although he and others tried hard to have the Federal Administration stop this drainage of a vital resource.

Commenting on demands from outside the industry for a direct increase of from 10 to 20 per cent in capacity, Mr. Weir stated that such an addition would take at least three years and would deprive current steel users of four tons of steel for every 10 tons of additional capacity. Actually, he said, the various steel companies have been expanding since the war in a manner that would interfere least with current production. In aggregate, they will spend more than $1,000,000,000 and several hundred millions of dollars in addition will be required for improvements now in mind. At least 3,000,000 tons of new ingot-making capacity will be brought into production in 1947 and 1948, he said.

One cause of today's high prices, Mr. Weir said, was the national pattern of wage increases adopted following the war and added: "You remember the hysterical campaign in which the Administration and the unions joined to put this 'pattern' over—the strikes, the statistics, later admitted to be phony, the absurd contention—made with straight face—that wages are not a cost of production. You remember that the Administration, itself, finally set the amount of the increase and bludgeoned industry into accepting it.

Mr. Weir denied that the present level of steel profits is evidence that steel prices are too high. Profits, he said, are in proportion to production and sales and were slightly lower in the first six months of 1947 in proportion to sales than the average for the years 1939, 1940, and 1941. He stated that under present costs profits would be wiped out if steel operations declined to 80 per cent of capacity.

In discussing Europe's present condition, Mr. Weir said that the people in many countries do not work long or hard enough. On his recent trip to Europe, he was surprised to find the work-week limited to 40 hours or less despite lagging industrial production. As examples, he pointed to the present British coal production of 180,000,000 tons annually, compared with 240,000,000 tons before the war, and to similar conditions in France. He attributed the main responsibility to bad government leadership which encourages people "to believe they can live without working and that government will take care of their every need from cradle to grave."

If aid is granted to any country, Mr. Weir said, it should be under an agreement that the aid will be used in a specified manner subject to check by United States representatives and subject to cancellation in event of misuse.

In seeking to promote the system of personal freedom and the free economy in other countries, we must not neglect it at home, Mr. Weir said.

Inspection Trip to Tube Plant by Akron-Canton Section

On Oct. 22 the members made a trip through the Babcock & Wilcox tube plant at Alliance, Ohio, preceded by dinner at the Alliance Country Club. E. W. Allardt, member A.S.M.E., chief engineer of the plant, gave a paper entitled "Description of Plant and Process for the Making of Electric-Resistance-Welded Steel Tubes." He described in detail the process used by his company to make welded steel tubing, and explained why the process, as such, was established rather than the alternative methods that could have been used and why they were not.

Otto de Lorenzi, Speaker at Anthracite-Lehigh Valley Section

On Sept. 26 at the Hotel Penn-Stroud, Stroudsburg, Pa., Otto de Lorenzi, Fellow A.S.M.E., director of education, Combustion Engineering Company, New York, N. Y., gave a talk on "Pulverized-Fuel-Fired Furnaces." Mr. de Lorenzi covered the development of pulverized-coal firing, methods used in firing, and characteristics of 3 basic firing methods. He stressed photography as an invaluable research tool. Forty-eight were present.

Boston Section Hears Ollison Craig

On Oct. 30 at the Hotel Commander, Cambridge, Mass., an audience of 80 heard Ollison Craig, member A.S.M.E., Riley Stoker Corporation, Worcester, Mass., speak on "Trends in Steam-Generating Equipment." Mr. Craig traced the progress made in boilers and boiler equipment since 1900. He said the future trend may be to larger units. The attempt, however, to get better performance by going to

lower flue-gas temperatures will be discouraged because of corrosion dangers. More use of the binary cycle and coal firing, either direct or through hydrogenation of fuel, may be expected.

Central Indiana Section Enjoys Plant Tour

An interesting meeting, including a visit to the plant of the Roots-Connersville Blower Corporation, Connersville, Ind., was held on Oct. 17. After the plant inspection, dinner was enjoyed at the Connersville Country Club, followed by a talk by Forrest Nagler, life member of A.S.M.E., entitled "The Human Side of the Bikini Test." Mr. Nagler, who is chief mechanical engineer of Allis-Chalmers Company, asserted that "squawk boxes" will be more effective than air-raid sirens in future atomic warfare. The boxes will squawk from heat energy, and Mr. Nagler showed, in miniature, how the thing works now. He declared all nations will have about any information they need on the atomic bombs by 1951 and can make them by that time—if they have the equipment. Mr. Nagler was director of machinery development for the atomic manufacturing at Oak Ridge, and spoke of his experiences while witnessing the second underwater burst at Bikini. W. T. Hornaday was the "coffee speaker." Mr. Hornaday is deputy attorney general assigned to the new division of Public Works and Supply in the State House. He spoke of his general experiences in the office of Strategic Services during World War II.

Engineering Research, Topic at Chicago Section

On Oct. 17 at the Sheraton Hotel, Chicago, Ill., the heat transfer and fluid flow Division of the Section heard Prof. Boris A. Bakhmeteff, member A.S.M.E., Columbia University, New York, N. Y., speak on "Engineering Research." Professor Bakhmeteff discussed the general aspects of postwar engineering research, particularly the proposed expenditure of two billion dollars over the next ten years by the government for fundamental engineering research. He stressed the need for the universities to train scientific engineers to conduct this work and to initiate fundamental research programs. Eighty-seven were present.

Central Iowa Section Hears Armour and Company's Chief Engineer

On Oct. 21 at the Hanford Hotel, Mason City, Iowa, an audience of 55 heard O. A. Anderson, member A.S.M.E., chief engineer, Armour and Company, speak on "Engineering in the Meat-Packing Industry." Mr. Anderson discussed the dependence of the industry on engineering; the types of engineering involved; the responsibility of the engineering department toward the success of the industry; and the opportunities for the engineer in this particular field.

Cincinnati Section Hears Two Speakers

On Oct. 2 in the Schneider Memorial Building, Cincinnati, Ohio, two speakers entertained an audience of 27 members and 27 visitors. Dr. I. A. Balinkin gave an excellent lecture and spectacular demonstration of color make-up and combinations with special effects. Mrs. Mary Held demonstrated modern lighting performance with certified lamps.

Columbus Section Inspects Battelle Laboratory

On Sept. 26 at Battelle Memorial Institute, Columbus, Ohio, 39 members and guests inspected the coal-burning gas turbine in operation in the Battelle laboratories. They observed testing of oil-film thickness and wear on sleeve bearings, and viewed plastic impressions of bearing surfaces through the Battelle electron microscope.

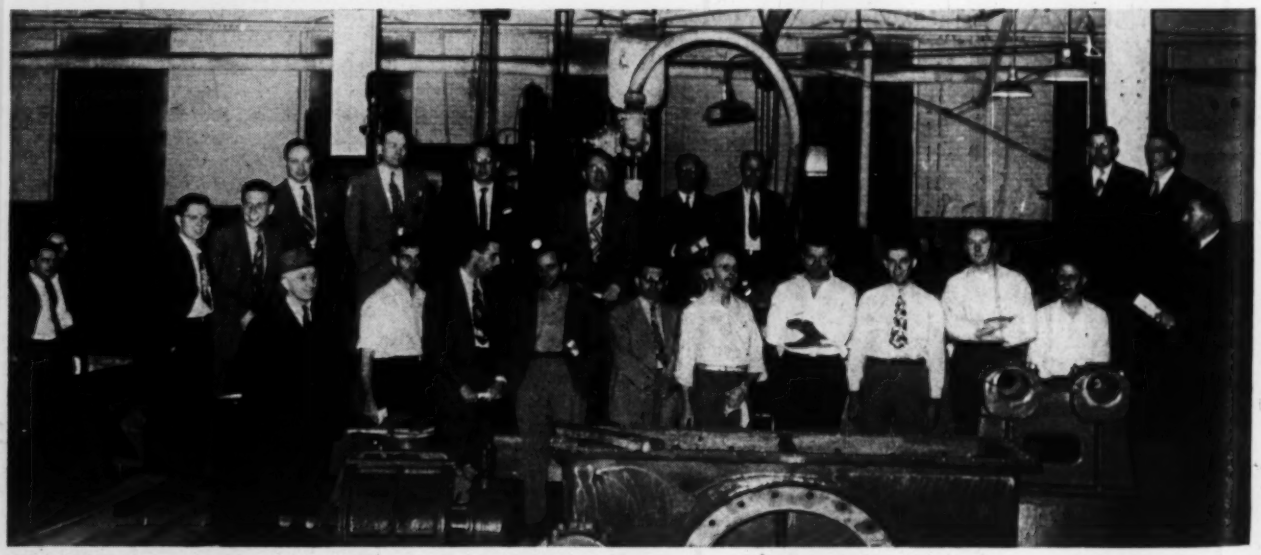
Harry B. Osborn, Jr., spoke on "Induction Heating" at the Battelle Memorial Institute, Columbus, Ohio, on Oct. 15, before an audience of 42. Dr. Osborn discussed the history, principles, and industrial application of induction heating, and illustrated the talk with slides showing industrial installations.

Dayton Section Greets Two Speakers

On Oct. 22 at the Engineers' Club of Dayton, Ohio, Otto de Lorenzi, Fellow A.S.M.E., director of education, Combustion Engineering Company, New York, N. Y., gave a talk entitled "A Study of Stoker Fuel Beds;" and H. L. Roe, supervisor of steam distribution for the Dayton Power and Light Company, spoke on "Some Problems in Central Steam Distribution." Mr. de Lorenzi showed a colored film of what goes on in a "burning fiery furnace." The pictures were close-ups in slow and fast motion and showed the action of four types of stoker fuel beds in action. Mr. Roe presented charts showing the development of central steam distribution in Dayton from 1906 to the present. Following the talks, the members inspected the Dayton Power and Light Company's steam generating station at E. Third and Webster Streets, and saw the new boiler which has been installed.

Fairfield County Section Told of Use of Electronics

On Oct. 7 in the Connecticut Power Company auditorium, Stamford, Conn., Gordon Volkenant, electronics authority with the Honeywell Company, Minneapolis, Minn.,



MEMBERS OF THE A.S.M.E. CENTRAL INDIANA SECTION DURING AN INSPECTION TRIP THROUGH THE SHOPS OF THE ROOTS-CONNERSVILLE BLOWER CORPORATION, CONNERSVILLE, IND., OCT. 17, 1947

MEMBERS OF THE A.S.M.E. FORT WAYNE SECTION VISIT SALISBURY AXLE WORKS, DANA CORPORATION, FORT WORTH, IND.

(*Left to right:* R. E. Gallatin, Virgel Stump, N. W. Kimmel, R. B. Solberg, E. W. Hackney, and Ivan E. Calicoate.)

spoke on "Electronics" to an audience of 125. With a small compact device containing miniature tubes, he rang a bell on the stage while he was standing in the audience, turned on lights, blew a siren, and startled his audience when he fired a "shell" across the stage. Dr. Volkenant said that electronic methods had been developed to the point where their sensitivity was such that the light put out by a star could be measured and time could be figured to the millionth of a second. Although very small, the electronic tube has vast power, he declared, and during the last war was used in the fuses of shells, adding greatly to their effectiveness. He felt that the new type of tube is gradually replacing the conventional radio tube because of its greater power and simplicity.

The Sikorsky Helicopter Discussed at Hartford Section

On Oct. 14 at the City Club, Hartford, Conn., an audience of 78 heard a talk entitled "Development of the Sikorsky Helicopter," by Edward J. Nesbitt. Following an interesting description of early models, present applications of the helicopter to crop spraying, transportation from downtown areas to airfields, rescue operations, and military operations were presented.

Fort Wayne Section Visits Salisbury Axle Works

On Oct. 2 an inspection trip was made by 20 members and 10 visitors through the Salisbury Axle Works, Dana Corporation, Fort Wayne, Ind. After a dinner served in the company's cafeteria, Mr. Calicoate invited the members and guests to view the operation of their new factory manufacturing rear-axle assemblies for Studebaker, Kaiser-Frazer, Ford, and others. Members of the management served as guides, and the tour was made in small groups so that personal attention could be given to all. The groups witnessed a marvel of modern mass production in which all machine tools and methods were of the most advanced type. Particularly outstanding were the features of high productivity per machine and per man, plus close working dimensions.

Metropolitan Section Hears Admiral C. W. Styer

A prediction that the submarine will increase in stature as a flexible and effective weapon along with the increasingly important role of atomic and guided-missile warfare, was made by Rear Admiral C. W. Styer, U. S. Navy, at a meeting in the Engineering Societies Building, New York, N. Y., on Oct. 24. A graduate of the U. S. Naval Academy, Admiral Styer is Co-Ordinator of Undersea Warfare. In his talk the Admiral visualized the development of special types including bombardment and carrier submarines to carry guided missiles or pilotless aircraft undetected to the shores of any future enemy, also picket submarines, cargo carriers, and transports for insuring hemisphere defense. He discussed new propulsion methods, higher submerged speed, and the possibility of an end to dependence on propulsion systems which require battery charging. He said that the Navy is striving to develop a means of efficient underwater communications, a matter of great tactical importance. Admiral Styer cited examples of the effectiveness of submarines in long-range scouting and offensive action, and discussed briefly the role of the submarine in long-range reconnaissance, supply missions, shore bombardment, mine-laying, and as a "lifeguard" for over 500 downed aviators. He said that U. S. submarines are all of one general type, and the general design and dimensions remained substantially the same throughout the war. Early combat experience brought modifications within the hull, such as change from electrically operated equipment to full hydraulic operation; addition of detached pumps, operating independently of the engines, to solve the problem of excessive engine heat; and doubling of the air-conditioning plant.

Mid-Continent Section Opens Season

The first fall meeting was held on Sept. 30 in the Tulsa Hotel, Tulsa, Okla., with 60 members and guests present. An interesting paper entitled "The Gas Diesel Engine Cycle"

DISCUSSING PLANS FOR INDUSTRIAL EXPOSITION TO BE HELD IN MILWAUKEE DURING THE A.S.M.E. SEMI-ANNUAL MEETING, MAY 30–JUNE 5, 1948

(Shown, *left to right*, at Hotel Schroeder on Oct. 23: H. L. Heywood, chairman of the Milwaukee Section, A.S.M.E.; Ernest Hartford, executive assistant secretary, A.S.M.E.; Thomas S. McEwan, regional vice-president, A.S.M.E.; and Theodore A. Wetzel, general chairman.)

was given by Raymond A. Darling, sales engineer, Cooper-Bessemer Corporation. He emphasized the economics of the gas Diesel engines versus the liquid-fuel Diesel engines, and said that the use of natural-gas fuel in the Diesel engine indicated considerable savings in cost of operation over the use of liquid Diesel fuel. A motion picture was shown giving the history and showing the modern techniques in the manufacture of Cooper-Bessemer engines. A discussion period followed.

Iron-Powder Metallurgy Subject at New Haven Section

An audience of 41 attended the meeting on Oct. 8 in the United Illuminating Company auditorium, New Haven, Conn. Jerome F. Kuzmick of Ekstrand and Tholand, Inc., gave a talk on "Iron-Powder Metallurgy." He showed two interesting films on the subject and then discussed some of the problems and advances in the art, with a frank discussion of the fields of application, limitations, and possible future of iron-powder metallurgy.

North Texas Section Discusses Master Plan for Dallas

On Oct. 6 in the Stoneleigh Hotel, Dallas, Texas, the subject was "The Master Plan for the City of Dallas." Granville W. Moore, vice-president and general manager, Dallas Planning Council, presented an interesting discussion of the accomplishments and plans of the Dallas Planning Council. A lively discussion period revealed the interest of members in city bonded indebtedness, parking of automobiles, water supply and distribution, and other problems arising from the expansion and growth of cities in this region.

Talk on Impulse Steam Trap at Ontario Section

On Oct. 9 in Hart House, University of Toronto, Toronto, Ont., Can., 30 members and 14 visitors heard Jackson Kemper speak on "Research and Development of the Impulse Steam Trap." This talk dealt with the theory of fluid flow through two orifices in series and the research necessary to develop and apply it to the design of the impulse trap.

Dinner and Smoker Starts Season for Philadelphia Section

On Oct. 13 in the Engineers Club, Philadelphia, Pa., the meeting featured a dinner and smoker, with professional entertainment, and provided an excellent early season get-together for members. Guests were present from the Washington, Los Angeles, and Boston Sections, and Wilmington and Trenton Subsections. Three hundred and twenty-five were in the audience.

At the University of Pennsylvania, Philadelphia, Pa., on Oct. 21, Dr. Gordon Brown, director, Servomechanisms Laboratory, Massachusetts Institute of Technology, Cambridge, Mass., spoke on "Dynamics: The Active Factor in Process Control." The speaker showed by means of a few simple concepts, that the entire reasoning behind servomechanism theory is directly applicable to industrial processes. He also showed that by means of two simple time functions the complete control characteristics of any closed loop control system may be specified. Ninety were present.

Plainfield Section Hears Talk on Copper

On Oct. 15 at the Elks Club, Elizabeth, N. J., the subject was "Copper as an Engineering Material." The speaker, S. R. Skowronski, covered the properties of copper, namely, electrical, thermal, mechanical, chemical, and alloying, and accompanied the talk with slides. He said that our future supply of copper, although not unlimited, is ample. Eighty-seven were in the audience.

Tools of Industry Discussed at Raleigh Section

On Sept. 29 at the Cape Fear Club, Wilmington, N. C., L. F. Ormond spoke on "Tools of Industry." The five "tools of management" were discussed as follows: Engineering, sales, operations, legal, and the accounting group. The speaker also discussed at some length the responsibilities of the engineering group and explained how the accounting department can aid engineers. He emphasized the need for closer co-operation between all the tools of management, and said this was necessary to combat the forces seeking to destroy our industrial system. Thirty-eight were present.

Rochester Section Has Well-Attended Meeting

"Research and Better Living" was the topic discussed at the Oct. 8 meeting in the Hotel Sheraton, Rochester, N. Y., before 32 members and 40 guests. The speaker, Larry F. Livingston, manager, extension division, E. I. du Pont de Nemours Company, credited a 50-year advance in industrial progress to taking inventors out of sheds and attics and putting them in modern research laboratories with ample funds. Mr. Livingston described many instances in the plastics field where logically gathered ideas have expanded into industries making jobs that never existed before for thousands of people, and raising living standards of the average American.

Two Speakers Heard at St. Louis Section

A joint meeting of the Section with the Engineers Club of St. Louis was held on Oct. 23 in the Engineers Club auditorium, St. Louis, Mo. Two speakers, F. A. Faville, member A.S.M.E., president Faville-Le Vally Corporation, Chicago, Ill., and L. J. Fletcher, member A.S.M.E., Caterpillar Tractor Company, Peoria, Ill., discussed the "Engineer's Place in the Community." Both speakers stressed the need of reselling Americans on the American system of free enterprise. They indicated that the engineer, with his analytical mind, was better qualified than any of the other professional men to promote this work. One hundred and fifty were in the audience.

Traffic Problems Discussed at San Francisco Section

On Oct. 23 at the Engineers' Club, San Francisco, Calif., three speakers of the San Francisco City Planning Committee discussed traffic and transportation problems in their city. The speakers were T. J. Kent, Jr., J. H. Turner, and H. C. Vensano. The following were taken up: relief of existing traffic problems; system to handle large volume of individuals between industrial, business, and outer residential areas; traffic arteries co-ordinated with California State plans for a freeway through the city; elimination of in-town curb parking of private cars in business areas; high-speed loop-circling business areas for private auto parking. Thirty-nine were present.

Talk on Plastics Heard by Schenectady Section

On Oct. 23 at the Hotel Van Curler, Schenectady, N. Y., K. W. Given of the chemical department, General Electric Company, gave a talk on "Plastics." The speaker illustrated his talk with many examples and samples. A lively discussion followed led by H. M. Patterson, managing engineer of the Plastics Division, General Electric Company. Fifty were in the audience.

Southern California Section Holds Two Meetings

A. M. Whistler, C. F. Braun and Company, Alhambra, Calif., spoke on "Economics of Heat-Recovery Exchangers" at the Sept. 9 meeting at the Rio Hondo Golf Club. This was a general meeting sponsored by the Heat Transfer Division, with 110 members and guests present. Mr. Whistler's paper was a timely exposition of the dollar-saving possible through proper arrangement of heat-recovery systems.

On Sept. 23 a fine trip was made by 40 members through the bottle manufacturing, labeling, and packaging plant of the Owens-Illinois Glass Company, Vernon, Calif.

Southern Tier Section Hears Talk on Low-Temperature Welding

On Oct. 27 at the N. Y. State Institute of Applied Arts and Sciences, Binghamton,

N. Y., Arthur Bilco of the Eutectic Welding Alloys Corporation, gave a talk and demonstration of the welding of aluminum and magnesium. Tracing briefly the history of low-temperature welding, Mr. Bilco stated that development work was started in Switzerland around 1906. The process was imported to this country about 1941 and proved to be the solution to many heretofore impossible welding problems. It was extensively used in war production and has been reported to have solved the special pipe-welding problems at the atomic-bomb plants. The low-temperature fusion of metals is accomplished by the fusion of surface alloys formed by the special Eutectic welding rods, explained Mr. Bilco. He went on to demonstrate the techniques required for the successful welding of aluminum, magnesium, and steel.

Destructive tests of the welds could not tear the welds but tore the metal several inches from the weld.

A.S.M.E. Member Speaker at Tri-Cities Section

On Sept. 23 at the Blackhawk Hotel, Davenport, Iowa, F. A. Faville, member A.S.M.E., president, Faville-Le Vally Corportation, Chicago, Ill., spoke on "The Engineer and His Community." The speaker strongly urged members of the engineering profession to participate in local affairs and make their influence felt in government. Thirty-one were present.

Hobby Show Feature of Toledo Section's First Meeting

On Sept. 23 the Section held its first meeting of the fall season, with a dinner at the Toledo Edison Club, Toledo, Ohio. A hobby show was featured in which members participated with talks, displays, and pictures. Peter R. Knapp, general superintendent of Toledo Edison Company, displayed his own paintings, carvings, and photographs. H. O. Hem, retired chief engineer of the Toledo Scale Company, spoke on watch and clock mechanisms, describing his work on a sidereal and solar clock which also plots the moon's phase and course. He displayed a pocket watch that not only told the time but also told how long since it had been wound. William Nelden, branch manager of the B. F. Sturtevant Division, Westinghouse Electric Corporation, demonstrated the most diversified hobbies; displays and discussions were given on linoleum-block printing, wood carving, pistol shooting, and photography. Neal Dorman, standards engineer, E. W. Bliss Company, discussed and presented several fine photographs he had made. Royse Moran, engineering accountant, Toledo Edison Company, spoke on various modes and phases of transportation through the years, and illustrated with pictures and maps.

Ernest G. DeCoriolis, director of research, Surface Combustion Corporation, avowed his love for classical music and lamented the fact that to date there is no recording device which will both eliminate noise and still faithfully reproduce true tone. Charles R. Pomeroy, engineer, Toledo Scale Company, gave a talk on a trip to Alaska he had made.

David S. Frank, superintendent, Toledo plant, Pure Oil Company, showed an interesting film concerned with oil and gas burners applied to modern boilers. Twenty-four members and guests attended the meeting.

Romance of Metals Discussed at West Virginia Section

At the Charleston Woman's Club, Charleston, W. Va., on Oct. 28, "Romance of Metals," a talk by S. M. Norwood, vice-president, Electro Metallurgical Corporation, was heard by 55 members and 30 visitors. Mr. Norwood explained the function of alloys in the production of steels, stressing their effect on the conservation of our resources. The audience found him a very excellent and entertaining speaker.

AT THE A.S.M.E. TOLEDO SECTION HOBBY SHOW

(*Left:* W. A. Nelden before an exhibit of his many hobbies. *Right:* N. W. Dorman explains how he took one of his choice photographs.)

Washington, D. C., Section Starts Season

"The Heat Pump" was the subject of a talk by E. R. Ambrose, at the Oct. 9 meeting in the Potomac Electric Power Company auditorium, Washington, D. C. An interesting and spirited discussion period followed. The high degree of interest centered on initial cost. Forty-four members and 36 guests attended the meeting.

A.S.M.E. Sections

Coming Meetings

Anthracite-Lehigh Valley: January 23. Lehigh University, Bethlehem, Pa., at 8:00 p.m. Subject: Modern Dual-Engine Truck Design, by J. William Putt, chief engineer, Hahn Motors, Inc.

Cincinnati: December 4. Engineering Societies Building, Cincinnati, Ohio, at 6:30 p.m. Subject: Forming Metal Products by Impact, by R. E. W. Harrison, vice-president of Chambersburg Engineering Company, Chambersburg, Pa.

Kansas City: December 8. University Club; Dinner meeting at 6:30 p.m. Subject: Research in Industry, by Dr. Dohrenwend, research consultant, Midwest Research Institute.

New Haven: December 10. Ladies Night—Donald K. Tressler, consulting food technologist, will speak on "Home Freezers and The Home Freezing of Foods."

New Orleans: December 8. St. Charles Hotel at 8:00 p.m. Subject: High-Energy Atomic Particles and Their Industrial Application, by Jack T. Wilson, physicist, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Ontario: December 11. Hart House, University of Toronto, Toronto, Ont., Can., at 7:30 p.m. Dinner will be served in the Graduate Dining Room, Hart House at 6:00 p.m. Subject: The Engineer In the World of Tomorrow, by T. M. Medland, executive director, Association of Professional Engineers, Ontario, Can.

Philadelphia: December 9. Engineers Club at 7:30 p.m. Subject: The Future of Railroad Transportation, by E. C. Gegenheimer, assistant general manager, eastern region, Pennsylvania Railroad Company.

December 16. University of Pennsylvania at 8:00 p.m. Subject: New Forms of Airplane Propulsion, by Arnold H. Redding, Westinghouse Electric Corporation.

South Texas: December 12. Sheffield Steel Corporation, Houston, Texas, at 5:00 p.m. Inspection of steel mill, including blast furnace, open-hearth furnaces, bar, plant, and wire mills. Inspection will be followed by dinner at company dining room and a business meeting.

West Virginia: December 9. Charleston Woman's Club; dinner at 6:30 p.m.; meeting at 8:00 p.m. Subject: Air Transportation, by Jennings Randolph, assistant to president, Capital Airlines.

Student Branches

University of Akron Branch

Election of officers was held at the Oct. 21 meeting in Simmons Hall. Prof. W. M. Petry, junior member A.S.M.E., was elected honorary chairman to fill the vacancy left by the resignation of Prof. F. S. Griffin, member A.S.M.E. The new officers are: Robert J. Harry, chairman; Roy R. Wiseman, vice-chairman; Crandall R. Kline, secretary, and Harold C. James, treasurer. Thirty members were present.

University of Arizona Branch

At the Oct. 16 meeting in the patio of the Engineering Building, Prof. M. L. Thornburg, member A.S.M.E., head of the mechanical-engineering department, spoke on "Graduation. What's Then!" He discussed the problems faced after graduation, and explained the requirements a company such as Allis-Chalmers or Chrysler Corporation demands of its men. He also spoke of the jobs held by graduates of former years. Seventy attended the meeting, the biggest turnout in the history of the branch.

Brown University Branch

The first official meeting was held on Oct. 7 in the Engineering Building. Prof. J. Warren, junior member A.S.M.E., assistant professor in the department of mechanical engineering, was re-elected honorary chairman. The following officers were elected: Harry K. Sleicher, chairman; Robert M. Wils, vice-chairman; and Richard Chakroff, secretary-treasurer.

Bucknell University Branch

On Oct. 1 in the Engineering Building, 58 members attended a meeting for the purpose of electing new officers, who are as follows: chairman, Arthur G. Rowe; vice-chairman, George S. Raab; secretary, James M. Stahl, Jr.; and treasurer, John B. Clark. A movie entitled "Tale of Two Cities" was shown, which dealt with the atom bombing of Japan.

University of California Branch

The first meeting of the new semester was held on Oct. 1 in 104 Engineering Building, and was called to order by Charles Kohlenberger, chairman. Mr. Bollo, research engineer at Shell Development, spoke on "Fire Hazards in Aircraft," and discussed the advantages and disadvantages of low-volatile fuels and conventional fuels with respect to tank explosions, ignition in the open, autoignition, and rate of fire spread. He illustrated his talk with a 15-minute movie. Mr. McBride presented a certificate of award to Sinclair Knapp in recognition of his outstanding effort and accomplishment in behalf of the branch during the school year 1946-1947.

On Oct. 23 the speaker was Ira M. White, member A.S.M.E., chief engineer, Pelton Water Wheel Company, who gave a talk on the 65,000-hp pump at Grand Coulee Dam. These pumps, when installed, will be the largest in existence.

Colorado A. & M. College Branch

The first meeting of the new school year was held on Oct. 6 in the mechanical-engineering building. New students were welcomed by Robert A. Brimmer, chairman. Prof. J. T. Strate, member A.S.M.E., head of the mechanical-engineering department, was the speaker. He discussed the advantages of membership in student branches of professional societies. Forty-four were present.

On Oct. 20 a regular meeting was held, with 81 present. Members donated $10 to a fund to finance the publication of "The Slide Rule," student engineering monthly. A film "Resistance Electric Welding," product of the General Electric Company, was shown. The processes of spot, projection, seam, and flash welding were portrayed.

Cornell University Branch

The first fall meeting was held in Sibley Hall on Sept. 30 with an attendance of 110. Dr. Arthur S. Adams, member A.S.M.E., provost of Cornell University, discussed "The Engineer as a Citizen." A certificate of merit was presented to Miss Shirley Ogren in recognition of her outstanding work for the Society at Cornell. This is the first time in the history of A.S.M.E. that this award has been given to a woman.

The meeting on Oct. 8 featured a talk "The Fight Against Vibration and Noise," by R. O. Fehr, General Electric Company, Schenectady, N. Y. After the fundamental laws of vibrating bodies had been stated and explained, Dr. Fehr discussed the applications of the principles to mechanical design, illustrating his points with slides. Eighty were present.

On Oct. 23 in Olin Hall, before an audience of 205, G. F. Aiken, instrumentation engineer, Eastman Kodak Company, presented a lecture demonstration on automatic controls. A hypothetical manufacturing process was developed to illustrate basic problems in control and the solution of these problems was explained with the aid of a plant mock-up. The lecture is recommended for other branches. Prof. C. R. Otto, member A.S.M.E., president of the Southern Tier Section, presided at the meeting. A dinner preceded the program.

At the Oct. 30 meeting in Sibley Hall, John R. Bangs, member A.S.M.E., director of industrial relations, Budd Company of Philadelphia, Pa., spoke to a capacity audience of over 300 students and faculty, on "Management—A Profession." Particular emphasis was placed on the so-called six M's of management—money, men, methods, markets, materials, and machinery.

University of Detroit Branch

The first meeting of the school year was held on Sept. 25 in the Union Room, with 110 present. New officers elected are: Richard Teasel, chairman; Charles Ratzel, vice-chairman; George Kurajian, treasurer; and Harlan Hanson, secretary. Prof. George B. Uicker, member A.S.M.E., honorary chairman, gave a talk on the advantages of joining A.S.M.E., and the preparation of a Charles T. Main paper. The branch has a membership of 145.

Drexel Institute of Technology Branch

The opening meeting of the fall term was held on Oct. 1 in the Student Building. Chairman John Gurniak made a few introductory remarks about the officers, and membership in the A.S.M.E. He then introduced Mr. Klein of the Brown Instrument Company, who gave a lecture on "Instrumentation and Automatic Control." The speaker explained the various types of automatic controls used today, why they are used, and illustrations of where they are used in typical installations. Applications for new memberships and renewals were received. About 45 joined as student members, and several indicated they would join within the following week. Sixty-eight were present.

University of Florida Branch

On Oct. 2 in room 101, Building F, the first meeting of the new season was held. The chairman, Walter B. King, Jr., read suggestions from the student manual for creating interest and activity in the branch, and then asked the faculty adviser, Prof. N. C. Ebaugh, member A.S.M.E., to make some pertinent remarks on the subject. A plan for student speakers was discussed, and Mr. Hart was asked to speak at the next meeting. Mr. Russell was appointed chairman of the publicity committee, and Mr. Jackson, chairman, program committee.

A second meeting was held on Oct. 16. Plans for coming events were discussed, including an exhibit for the annual homecoming week end.

George Washington University Branch

On Oct. 1 in room 101, Government Building, all the engineering societies on the campus joined in the annual Engineers' Mixer. Ben Sorin, president of the Engineers' Council, presided. Dean F. M. Feiker, associate A.S.M.E., spoke briefly on the importance of learning to measure human nature, as well as material things. Fremont Jewell, the first engineering student in the history of the university to be elected president of the student council, outlined the functions of the council which co-ordinates the activities of all student organizations on the campus. The reactivated Alumni Association, represented by P. H. Girard, research and development section, Bureau of Ordnance, Navy Department, offered guidance and assistance to any student needing help. The Alumni Association, he announced, has voted $200 for publication of the *Mechelectiv*, the monthly engineering paper published by the students. A 30-minute recess enabled interested students to join the engineering societies of their choice. Herbert H. Murray, chairman, presided at the A.S.M.E. branch meeting, and Prof. B. C. Cruickshanks, member A.S.M.E., gave a short talk. Fifty-two signed up for membership in the branch. The entire audience of 200 then enjoyed a Navy Department film entitled "Construction of a Naval Base by the Seabees."

Illinois Institute of Technology Branch

The first meeting of the fall semester was held on Oct. 21 in North Union Building. I. C. Hamilton, president of the branch, announced the start of a drive for membership. He then introduced Prof. S. E. Rusinoff, member A.S.M.E., honorary chairman. Professor Rusinoff gave a brief outline of the calendar of events for the coming semester. He introduced the guest speaker, W. H. Oldacre, member A.S.M.E., president and general manager, D. A. Stuart Oil Company, who spoke on "Why Should I Belong to the A.S.M.E.?" In his talk Mr. Oldacre stressed the fact that the student member has an opportunity to show what he can do and an opportunity to grow intellectually with the organization. "Students must associate with their fellows to avoid life passing them by and shoving them into a corner," he said. One hundred and fifty were present.

Iowa State College Branch

At the Oct. 1 meeting in south ballroom, Members Union, a report was given on the senior inspection trip by Don Elk. A brief talk on the A.S.M.E. was given by Prof. H. M. Black, member A.S.M.E., and members of the faculty present were introduced. A technicolor movie "Steam Progress" was shown. Two hundred and eighty were present.

University of Kansas Branch

The second meeting of the fall semester was held on Sept. 30 in the Student Union. F. R. Hunter, of the Kansas City sales office, Allis-Chalmers Company, was the guest speaker. He spoke on present-day gas and coal turbines, and illustrated with a film entitled "Tornado in a Box," showing the development of the gas turbine. An informal question period was ably handled by Mr. Hunter. Officers for the coming season are: John C. Sells, chairman; Steven Hadley, vice-chairman; Edward P. Hansen, secretary; and James McKinney, treasurer. Seventy-five were present.

Lafayette College Branch

The first meeting of the new school year was held on Oct. 9 in the mechanical laboratory, attended by 120 students. John S. Trogner, president of the branch, opened the meeting and introduced Prof. Paul B. Eaton, member A.S.M.E., head of the mechanical-engineering department. In his address Professor Eaton described the A.S.M.E. organization and pointed out various advantages of membership. The honorary chairman, Prof. William G. McLean, member A.S.M.E., head of the mechanics department, was introduced, and outlined plans for future meetings. A total of 97 students applied for membership at the close of the meeting.

On Oct. 30 in the mechanical laboratory, Stephen Polansky, a mechanical-engineering student from the senior class, spoke on "Analysis of a Gas-Turbine Cycle." His talk included a general survey of the historic development of gas turbines, as well as discussion of modern gas-turbine cycles. The guest speaker was Roy Porter, consulting engineer, New Jersey Zinc Company, who gave a talk entitled "Opportunities in Mechanical Engineering." Mr. Porter analyzed the present demand for graduates in the various fields of mechanical engineering, and said that he believes the present shortage of engineers will last up to 1951, and that therefore plenty of jobs are available for men interested in their work. Ninety-five were present.

Massachusetts Institute of Technology

On Oct. 9 the opening rally was held. Prof. H. E. Edgerton presented slides and a film on high-speed photography, as well as a demonstration of stroboscopic light. Practical applications were discussed, along with the humorous ones incident to the use of this vehicle for "stopping" motion. Forty-six applications for membership were accepted at the close of the meeting, after a talk on the advantages of the Society by student chairman, William Vangser, Jr. Two hundred and thirty were present.

Michigan State College Branch

On Oct. 10 in room 111, Olds Hall, 42 members were present. Charles Bachman, representative to the Engineering Council, revealed plans for a forthcoming Engineers' Dance to be held in November, the theme to be a "Red Worker's Rally." Chairman Harvey Wilson expressed his appreciation to Mr. Crossman for the excellent A.S.M.E. posters that the latter had provided. A voluntary committee was requested to contact the juniors in their thermodynamic-computation periods. Messrs. Williams, Gillisse, Foster, Snyder, Campbell, and Hoehn responded.

University of Minnesota Branch

Two meetings were held during October; the first, Oct. 8, in the Men's Lounge of Student Union, was devoted to election of officers and to familiarize nonmembers with the A.S.M.E. New officers are: Harold H. Danforth, Jr., chairman; Francis J. Green, vice-chairman; Robert W. Ernt, secretary; and Arnold Smith, treasurer. Visitors were welcomed by Mr. Danforth, Prof. B. J. Robertson, member A.S.M.E., representing the mechanical-engineering department, and Prof. A. O. Lee, junior member A.S.M.E., honorary chairman, representing the Minnesota Section of A.S.M.E.

The second meeting, Oct. 22, was strictly a business meeting. Committees were set up and general policies for the coming year were planned.

Mississippi State College Branch

The opening meeting, a combination smoker and business meeting, was held on Sept. 25 in room 106, Engineering Building. E. K. Strahan, chairman, distributed application blanks and introduced the speaker, A. G. Holmes, member A.S.M.E., dean of the mechanical engineering school. Dean Holmes outlined the ideals and benefits of A.S.M.E. H. P. Neal, junior member A.S.M.E., a former honorary chairman, gave a brief account of the benefits of attending the Regional Student Conference. The honorary chairman, R. T. Staton, junior member A.S.M.E., was called upon to instruct new members in the completion of their application.

On Oct. 2 C. B. Burgoyne was elected as honorary chairman for the coming season. W. H. Bending was elected secretary and treasurer. E. O. Gibson, a student member, told of his experiences with the Carnith Machine and Foundry Company.

Another meeting was held on Oct. 9 with 38 present. The program chairman, James Hoyle, showed a film entitled "Uses of Machines."

The meeting on Oct. 23, attended by 46, featured a talk by T. D. Kennedy, supervisor of sundry sales, Pittsburgh Paint and Glass Company, Pittsburgh, Pa., entitled "Color Dynamics." Mr. Kennedy illustrated the talk with a series of charts which outlined the use of paint to increase production and decrease accidents.

University of Nevada Branch

Acting chairman Trail called the Oct. 8 meeting to order, with 33 present. Election of officers was held, and the following were placed in office: Mr. Coe, chairman; Mr. Tallia, co-chairman; Mr. Weber, secretary; and Mr. Helmick, treasurer. Two films were shown, the first on the Eighth Air Force, and the second on Caterpillar Tractors.

New York University (Evening School) Branch

On Oct. 16 in Lawrence House an audience of 150 attended a meeting which was opened with the introduction of officers and chairmen of committees. Prof. F. L. Singer, member A.S.M.E., honorary chairman, gave a talk on "The Welfare of the Student Body." He discussed the idea of the student being "a square peg in a round hole," and emphasized the fact that too many work at something only for the monetary value which it holds. The best thing, he said, was to work at something one enjoys and feels is best suited for him. Professor Singer declared that too many students only want to know "how" to do something, instead of "why." He claimed that a full knowledge of basic engineering is very important to one's standing in the engineering field. He concluded his talk by mentioning the advantages which are gained by membership in the A.S.M.E., and mentioned the Engineering Library, use of which is available to students.

North Carolina State College Branch

The new semester was opened on Oct. 7 in 100 Page Hall, with 48 members present. Plans for the coming season were discussed and a program committee consisting of F. B. Morrison, S. B. Burwell, N. M. Fowler, J. C. Hobbs, and E. D. Pebbles, was appointed. The initiation committee consists of Basil Greene, J. L. Robinson, W. S. Griffith, M. M. Fowler, and D. R. Barineau. J. O. Darholt is publicity man. All members were urged to start technical papers to be entered in the many contests at the larger meetings.

University of North Dakota Branch

Chairman W. Ray Will called the season's first meeting to order on Oct. 1, in Chandler Hall, with 28 present. The Yarnall-Waring film "There Is an Engineering Reason" was shown, followed by movies taken at the engi-

neer's picnic held last spring. Membership forms were passed out and filled in by 19 students. Harry A. Glander, member A.S.M.E., was elected honorary chairman for the new season. The chairman appointed committees for membership, inspection trips, and publicity.

Ohio State University Branch

The first meeting of the fall term was held in Robinson Laboratory before an audience of 120. Wilson R. Dumble, professor of English, spoke on "The Sex Life of a Slide Rule." Tentative plans were made for a semiformal dance, "The Grease Ball." John E. Applegate, junior member A.S.M.E., was elected honorary chairman. One hundred and twenty were present. Officers of the branch are: Ralph E. Stinson, chairman; Victor N. Lagarias, vice-chairman; Gilbert C. Morris, secretary; and Henry F. Ingersoll, treasurer.

University of Oklahoma Branch

The meeting on Oct. 1 in the Engineering Auditorium was attended by 28, and opened by chairman Robert M. Wright. The speaker of the evening was Dr. W. H. Carson, member A.S.M.E., dean of the school of engineering, University of Oklahoma. Dr. Carson spoke briefly on his own personal experiences as a student member of the A.S.M.E., and discussed the university's participation in the Society, stating that the university had gained prestige by the following contributions: (1) Power required by the steam oil-well rig; (2) fluid measurements; and (3) other consulting work for A.S.M.E. In conclusion, he urged the officers and members of the branch to make the A.S.M.E. the dominant engineers organization on the campus.

Oregon State College Branch

The first meeting of the new school year was held on Oct. 2 in Chemistry 101, with 75 present. John R. Nelson was elected secretary. Walter Wilson, a student in industrial engineering, gave a short talk on his work of the summer on an automobile assembly line. He also told of his talks with a number of personnel men at different plants around Detroit. Gerald Cox said a few words about his job with an engineering-equipment company, and Bob Ohling told of his job with a refrigerating company in Portland. Prof. A. D. Hughes, member A.S.M.E., was chosen honorary chairman.

On Oct. 16 in Chemistry 101, a talk was given by Elmer A. Buckhorn entitled "Professional Recognition of the Engineer Through Registration." Mr. Buckhorn, a graduate of Oregon State, and a patent lawyer in Portland, Ore., is secretary of the State Board of Engineering Examiners. He stressed the necessity and desirability for the engineer to register with the state in a manner similar to that followed by doctors and lawyers. He also reviewed the Oregon law for registration of engineers.

University of Pittsburgh Branch

On Oct. 2 at the Cathedral of Learning, G. D. Lobingier, supervisor of student recruitment of the Westinghouse Electric Corporation, addressed the junior and senior members, totaling 177, on "How Westinghouse Recruits Its Student Personnel." Mr. Lobingier gave the audience pointers on the proper way to act while being interviewed, and also explained the opportunities open to the graduating engineers within the next two to three years. The members appreciated Mr. Lobingier's straightforward talk.

Dr. John M. Ferguson, professor in the economics department of the university, was the guest speaker at the meeting on Oct. 9. His subject was "Economics and the Engineer." He discussed the subject in his amusing and inimitable manner, and then answered questions. One hundred and seventy-seven attended.

On Oct. 16 the guest was William Rudoy, assistant professor of mechanical engineering, and football spotter for Pitt and Woody Wolff, KDKA announcer. He showed pictures of last year's football game between Ohio State and the University of Pittsburgh. Again, one hundred and seventy-seven were present.

Princeton University Branch

The first meeting of the calendar year was held on Oct. 9. Prof. G. W. Shepherd, Jr., Jun. A.S.M.E., and Dean K. H. Condit, member A.S.M.E., told of the advantages of the A.S.M.E. and urged immediate organization. The new officers are: Joseph Fischer, chairman; James Snyder, vice-chairman; John Davis, secretary; and Harland Oates, treasurer. Two movies were shown, "This Is Magnesium," and "Treasure From the Sea," on the making of magnesium from sea water. A third film, "A Natural Playground," followed. Forty were present.

Rensselaer Polytechnic Institute Branch

On Oct. 23 in room 214, Sage Laboratory, one hundred and ten students, members of the faculty, and guests met for the initial meeting of the branch. John O. Amstuz, member A.S.M.E., chief engineer, Behr-Manning Corporation, Troy, N. Y., spoke on the problems involved in job selection. He emphasized the necessity for personnel departments to use a system in selecting men for jobs; in other words, time and money are saved, he said, when the right man is found for the right job, before large expenses are incurred for training. He then analyzed the procedure, giving ten points on which a salesman is tested and graded. A question period followed the talk.

Rutgers University Branch

An organization meeting was held on Oct. 1 in Engineering 208, at which time the suggested constitution was read, discussed, and accepted. Frank Devine presented the names of two probable speakers and asked for suggestions for future field trips. Cliff Nagle received volunteers for a bowling league between the engineering societies. There were 62 present.

On Oct. 8 a film was shown entitled "The Building of the Golden Gate Bridge" by Bethlehem Steel Company. Fifty-eight attended the meeting.

South Dakota State College Branch

On Oct. 1 in the Aviation Building, the first regular meeting of the new school year was held with 70 students present. Vernon E. Bushnall, chairman, introduced the faculty members and officers of the branch to the new students. Prof. Lee L. Amidon, member A.S.M.E., honorary chairman, welcomed all present and spoke on the merits and benefits of the A.S.M.E. Branch secretary Duane L. Green signed up new members.

University of Southern California Branch

The first meeting of the new semester was opened by Harold A. Lichnecker, new chairman, on Sept. 25, in Science Annex D, 103. The new student officers, including the chairman, are: W. L. Homes, vice-chairman; M. G. Barnes, Jr., secretary; P. J. Dickey, treasurer. Prof. E. K. Springer, member A.S.M.E., is honorary chairman. The first speaker was R. G. Roshong, member A.S.M.E., who is in charge of student relations for the Southern California Section, A.S.M.E. Mr. Roshong spoke of the coordination between that Section and the student branches in this area, and then introduced V. L. Peickii, member A.S.M.E., who is also a member of the executive committee of the Southern California Section. Mr. Peickii gave an interesting talk on the organization of the A.S.M.E. and the benefits to be derived by the students who join the Society's branches. Professor Springer spoke on the preparing of papers which will be presented during contests next spring. One hundred and three were present.

Southern Methodist University Branch

At the Oct. 7 meeting in the Fondren Auditorium, Harry Pearson, member A.S.M.E., personnel director, Dallas Power and Light Company, Dallas, Texas, spoke on the objectives of the A.S.M.E. student-branch activities.

Twenty-eight new members were added to the organization which was open to all student engineers interested in joining the S.M.U. branch. W. W. Finley, vice-president and manager of the Guiberson Corporation, Dallas, Texas, spoke on the value of joining a group such as A.S.M.E. Dean E. H. Flath, of the school of engineering, urged the students to join the organization. Ray M. Matson, member A.S.M.E., head of the mechanical-engineering department, introduced the department instructors to the audience. Clifford H. Shumaker, member A.S.M.E., professor of mechanical engineering, and chairman of the A.S.M.E. North Texas Section, invited all student members to attend the section meetings which are held regularly in Dallas.

Stanford University Branch

On Oct. 29, through the compliments of the Food Machinery Corporation, San Jose, Calif., the members made a field trip to that plant. Mr. Leslie, a practicing engineer, conducted the group through the pattern shop, tool and die department, machine shop, assembly line, and boiler shop. There was evidence of A.S.M.E. Codes at work throughout the plant. Mr. Leslie told the group that all parts, whether cast, stamped, drawn, or otherwise formed, must conform to A.S.M.E. specifications. A.S.M.E. inspectors check

every rivet hole in the boilers before a single rivet may be driven.

Stevens Institute of Technology Branch

On Oct. 17 the first regular meeting of the new school year was held in Jacobus Hall, along with election of officers. New members filled out application blanks. The program committee, appointed by Joe De Felice, president, consists of: Sid Root, Vernon Buchanan, Charles Buckley, Hugo Cano, and C. D. Stephenson. Forty were present. The same day an inspection trip was made to the Jacob Ruppert Brewery in New York, N. Y. The group of 30 was led by Charles Buckley.

A sound movie, in color, "Steam Progress," was shown at the Oct. 20 meeting. It described the construction of steam boilers and pressure vessels, and was shown through the courtesy of the Combustion Engineering Company. A short talk on the advantages and privileges of membership in the A.S.M.E. was given by Mr. Moss, and new membership applications were accepted. One hundred and twenty-five were present.

Swarthmore College Branch

Election of officers was held at the Sept. 30 meeting in Hicks Hall, with the following results: W. Ford, chairman; H. Temple, vice-chairman; and S. Mucha, secretary-treasurer. Prof. W. E. Reaser, member A.S.M.E., new head of the mechanical-engineering department, gave a talk on A.S.M.E. activities. Twenty-four were present.

The meeting on Oct. 14 was for the purpose of filling out application blanks for the academic year. Questionnaires were handed to members to determine the main interests of the branch for future meeting programs. Seventeen were present.

University of Tennessee Branch

An organization meeting was held on Oct. 9 in Estabrook Hall, with 45 present. Gerald Scott was elected to fill the vacancy of vice-chairman made necessary by the graduation of Sam Bloom. Joe Woodson was elected to serve on the ACE board, together with Harold Winn and the chairman, Herman H. Morris. Prof. W. R. Chambers discussed "The Portals of New Mexico Irrigation Project." This discussion included description of the pumping station, transmission lines, and transformer station, and the central power stations which consisted of gas producers and large 4-cylinder double-acting tandem-duplex internal-combustion engine-driven generators installed about 1910.

On Oct. 23 the members appointed a publicity committee, consisting of Charles Cash, chairman, and Messrs. Huffstetler and Hines. The speaker was Vincent Matthews, who gave a talk on "Designing and Drafting as a Career." Mr. Matthews has been with the Alcoa plant for seventeen years, most of which have been spent with the designing department. An open discussion period followed. Thirty-three were present.

Texas A.&M. College Branch

The meeting on Sept. 30 was for the purpose of electing new officers, who are: C. E. Lennon, chairman; Tom Lamberth, vice-chairman; Edward A. Pela, secretary; and C. Y. Hendricks, treasurer. Bennett Boyd was appointed chairman of the membership committee. He asked for volunteers to help in a membership drive in the hall of the mechanical-engineering building.

Texas Technological College Branch

On Oct. 20 in the Engineering Building, room 108, Allan Barker of the Culligan Water Softener Service Company, showed an interesting film entitled "Hard Water, the Household Swindler," and gave a talk on the theory of softening water. Following the talk, Prof. L. J. Powers, junior member A.S.M.E., urged all members to attend the joint meeting of the Tech student branch and the A.S.M.E. North Texas Section, on Nov. 18. Talks were given by Professor Powers and Dan Gillett on the advantages of being an A.S.M.E. member. Sixty-three students filled out applications for membership.

Tufts College Branch

The first meeting of the new school year was held on Oct. 8 in Robinson Hall, with 91 members and guests present. Chairman Carl R. Fleming gave a brief talk on the aims and purposes of the A.S.M.E., the accomplishments of the Tufts branch, and the advantages of active participation by members. L. E. Newman, assistant manager, Lynn Turbine Sales Division, General Electric Company, spoke on "Crossroads Ahead," and brought out many problems confronting the graduating engineer. An interesting discussion period followed.

On Oct. 16 and 17 the members were guests of the management of the Ford Motor Company in Somerville, Mass. Two groups, of thirty-five men each, were formed, under the direction of W. H. Flavin of the Ford Motor Company. One of the most interesting phases of the trip was the illustration of the importance of scheduling in quantity production. The students were impressed with the close control of the flow of material through the use of the master schedule. A brief discussion of problems of mass production completed the tour.

A business meeting was held in Robinson Hall on Oct. 21, with 61 members present. Edward F. Casey and Richard A. Norwood were elected as A.S.M.E. representatives to the Engineers Council. This Council was formed for the purpose of co-ordinating and promoting engineering activities. The membership of the branch has risen to the 105 mark, an all-time high. This reflects the outstanding work of the membership committee of which John T. Swanton is chairman.

Vanderbilt University Branch

On Oct. 1 a meeting was held in Science Hall, at which time the following officers were elected: Sidney H. Acker, member A.S.M.E., honorary chairman; Sam E. Shelly, chairman; Tom C. Gibson, vice-chairman; Walter C. Gibson, treasurer; and Stanley Zane, secretary. Fifty-two were present.

Villanova College Branch

The "Opening Rally" of the first semester was held on Oct. 3, and opened by Joseph Beals, chairman. Prof. G. H. Auth, junior member A.S.M.E., honorary chairman, outlined briefly the many advantages that the branch offers the undergraduate, and told of the activities of this branch. The newly elected officers were introduced. They are: Joseph Beals, chairman; Richard P. Shinners, vice-chairman; Louis Alvare, secretary; and C. Donald Bradburn, treasurer.

Virginia Polytechnic Institute Branch

On Oct. 7 in the new chemistry-laboratory building a short business meeting was held. Plans were made and ideas discussed for the activities of the branch during the remainder of the quarter.

On Oct. 14 the film "Steel Plus" was shown. This film, loaned through the courtesy of the Bethlehem Steel Company, depicted the manufacture of tin plate at the company's Sparrow's Point plant. It showed the forming of ingots and the successive steps in the production down to the tin cans and other articles so common in our everyday use.

The meeting on Oct. 21 was devoted to the showing of a film "Quality in the Making," through the courtesy of the New Departure Ball Bearing Company. It depicted the high lights of ball-bearing manufacture, the kind of steel used, the rolling of the steel, the manufacture of the ball bearings, races, and inner and outer rings, and their final assembly.

At the Oct. 28 meeting W. A. Wilkinson and F. A. Wilbourne, seniors, and W. N. Cardella, a junior, were elected to represent the branch on the Engineering Club committee. The other junior on the committee previously appointed, is Mr. Breeding. A talk was given on the Babcock and Wilcox Company boiler by T. F. Little, a student member. A technicolor film, presented by Combustion Engineering Company, "Building Boilers for Ships," completed the program.

Washington State College Branch

The first meeting of the school year was held Oct. 1, and featured a cider-bust and membership campaign. Fifty members were signed up. Dr. William A. Pearl, member A.S.M.E., gave a short talk on the advantages of becoming a senior member of the A.S.M.E. Prof. F. R. Candee, member A.S.M.E., honorary chairman of the branch, told of the plans for the forthcoming Pacific Northwest conference at which the University of Idaho and Washington State College would be joint hosts.

University of Washington Branch

The initial meeting of the season was held in the Guggenheim Auditorium on Oct. 14. Chairman McNichols opened the meeting with a welcome to the new members, and introduced the officers. Prof. B. T. McMinn, member A.S.M.E., executive officer of the mechanical-engineering department, gave a short talk on the social responsibilities of engineers and explained how the majority of the great American engineers have felt it their duty to belong to, and further the work of the M.E.S.A. S. D. Vanek, junior member A.S.M.E., chairman, student-relations committee of the Western Washington Section, extended an invitation to members to partici-

pate in the forthcoming activities of the Section. Questionnaires were passed out to new members for the purpose of gaining information as to their interest in writing papers and participating in field trips.

University of Wisconsin

The first meeting of the fall semester was held on Oct. 14 in the mechanical-engineering building. Ed Hillery, vice-chairman, took over the chairmanship as Fred Pitschke, the elected chairman, did not return to engineering school. Prof. B. G. Elliott, member A. S. M. E., head of the mechanical department, gave an illustrated talk on his summer trip to the National Parks. Norman Benz was elected to the office of vice-chairman.

The secretary outlined the procedure for joining the A.S.M.E. and of transfer from student and junior status. Thirty-two were present.

Worcester Polytechnic Institute Branch

The first meeting of the new school year was held on Oct. 9 in Higgins Laboratory, with 47 present. To fill the vacancy created by the resignation of Robert L. Ballard, Samuel W. Cocks was elected secretary-treasurer. The new honorary chairman is Prof. M. Lawrence Price, junior member A.S.M.E., an alumnus of W.P.I., and head of the machine-design section of the mechanical-engineering department. A moving picture "Boulder Dam," made by the Babcock and Wilcox Company, was shown. It depicted the diverting of the river, the construction of the dam, and the construction of the steel liners for the underground water conduits.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative nonprofit basis. In applying for positions advertised by the Service the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3.50 per quarter or $12 per annum, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	211 West Wacker Drive	109 Farnsworth Ave.	57 Post Street

MEN AVAILABLE[1]

ENGINEERING EXECUTIVE, chemical engineer, 20 years' broad experience in project management; supervision of process development, equipment design, and application; administration of plant design, construction, and operation. Me-241.

MECHANICAL ENGINEER, 17 years' diversified experience in production, process planning, methods, and electrical and mechanical instruments. Age 39, married, B.S.M.E. Desires position in small factory, about 300 employees. Me-242.

MECHANICAL ENGINEER, bachelor's and master's degrees; at present, professor at large state university; desires industrial position in promotional, sales, editorial, or personnel work. Varied practical experience as well as successful consultant, author, and engineering teacher. Member four engineering honor societies; recently returned from European U. S. Army assignment; wide acquaintance. Me-243.

MECHANICAL ENGINEER, 30, graduate. Practical background in plant engineering. Ability as tool designer. Capable of directing work. Interested in a position eventually leading to responsibility in production engineering. East or Midwest preferred. Me-244.

DEVELOPMENT ENGINEER, mechanical graduate, 30 years' experience in machine and plant development in chemical and mechanical manufacture. Desires responsible position in pioneer development of mechanical product or process equipment. Me-245.

MECHANICAL ENGINEER, B.S.M.E. 24 years' experience in the design and development of small mechanical devices. Familiar with methods work and estimating. Available on short notice. Me-246.

POSITIONS AVAILABLE

SALES ENGINEER, to head briqueting-machinery division. Must be tops in field, with record of successful achievement in both engineering and sales. Write giving full details of experience, etc. Pennsylvania. W-9749.

MECHANICAL ENGINEER, with experience in design and development of jet-engine controls and aircraft hydromechanical equipment, to design and lay out aircraft accessories. $4800. New York State. W-9770.

ENGINEERS, (*a*) industrial engineer with minimum of 5 years' experience in time study, wage incentives, standards, etc., for machine shop. (*b*) Industrial engineer with experience, particularly on quality control. $6000 plus $360 bonus. Texas. W-9804.

PROFESSORS OR ASSOCIATE PROFESSORS. (*a*) Professor or associate professor of thermodynamics, to teach at graduate level. Should have master's degree, but a doctor's degree is desired. Should be qualified in the field of jet propulsion and gas turbines. Salary, about $6000 for nine months, depending upon qualifications. (*b*) Professor or associate professor of machine design to teach at graduate level. Should have master's degree, but doctor's degree is desired. Should have had good commercial experience. Salary about $6000 for nine months, depending upon qualifications. South. W-9805.

INDUSTRIAL ENGINEER, under 45, for aircraft manufacturer, particularly experienced in either scheduling and hours control or for material control, including warehouses. $5000–$6000. Maryland. W-9813.

INSTRUCTOR OR ASSISTANT PROFESSOR, under 50, M.S. degree and some experience in metal industry, to teach applied mechanics, strength of materials, and fluid mechanics. Oklahoma. W-9815.

SALES MANAGER, 30–50, with at least 10 years' experience in the heat-exchange-equipment field to supervise sales of heat exchangers in power and process fields. $6000 plus bonus. Northern New Jersey. W-9822.

PATENT ATTORNEY, registered, preferably mechanical graduate, with at least 5 years' experience covering instruments, controls, tools, and machinery, to act as assistant patent attorney for equipment manufacturer. Salary open. Headquarters, New York, N. Y., with occasional travel. W-9825.

PERSONNEL MANAGER, graduate business administration or economics with major in industrial relations or personnel management, with 10 or more years' experience in industrial relations, at least 5 years of which were in responsible charge, to supervise and be responsible for efficient operation of personnel department, first aid, and plant cafeteria. $5000–$9000. Pennsylvania. W-9832.

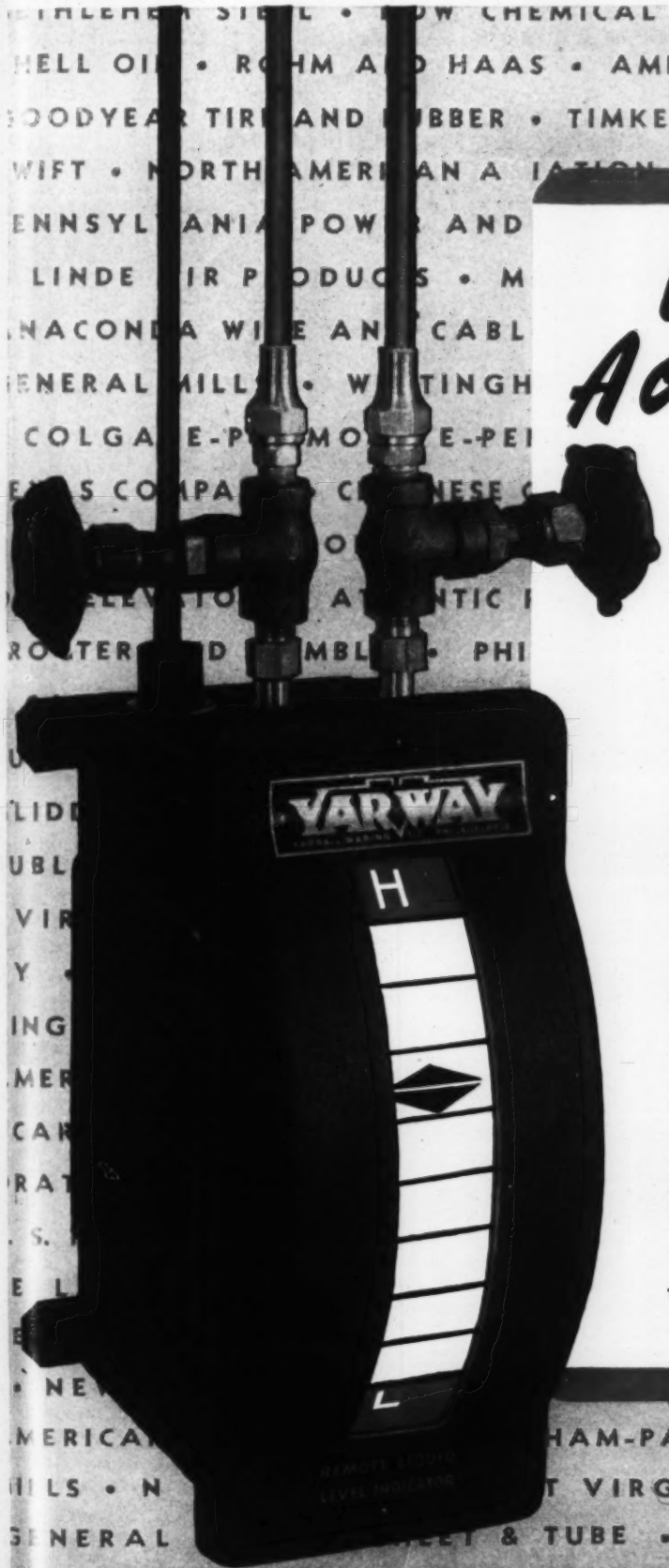
TEACHING PERSONNEL. (*a*) Instructor of industrial engineering, to teach courses in materials processing, machine-tool laboratory, or production engineering, time and motion study, preferably having 1 or 2 years' teaching experience. (*b*) Instructor in mechanical engineering, preferably with some teaching experience in heat power, laboratory, air conditioning, internal-combustion engines, heat transfer, and thermodynamics. Salary to $3800. Start February, 1948. Upstate New York. W-9843.

ENGINEERS. (*a*) Plant engineer, graduate, not over 45, experienced in heavy industry, primarily pulp. Must have had considerable experience in maintenance supervision and plant engineering. Salary from $6000 a year. (*b*) Maintenance supervisors, 35–45, with considerable experience in maintenance supervision, particularly throughout all trade groups. $4500. New Hampshire. W-9845.

(*A.S.M.E. News continued on page 1086*)

[1] All men listed hold some form of A.S.M.E. membership.

Wide Acceptance!



Though introduced only recently, thousands of Yarway Remote Liquid Level Indicators already have been bought . . . and the list of satisfied users reads like a Who's Who of Industrial Plants, Utilities and Institutions.

There *must* be a reason. There *is!*

The Yarway Remote Liquid Level Indicator brings overhead gage readings right down to eye level, on the instrument panel or other convenient place. No more squinting, straining and guessing. Here is *positive* water level indication . . . instant and accurate because it's operated by the boiler water itself.

Though used primarily for boiler water level indication, the Yarway indicator has proved equally successful in indicating superheater pressure differential, feedwater-heater levels and other liquid levels.

Write for Bulletin WG-1822, or see this indicator and hear its operation explained by Lowell Thomas in the new Yarway color motion picture, "There Is An Engineering Reason", now available for group showings. Write for details.

YARNALL-WARING COMPANY
108 Mermaid Ave., Philadelphia 18, Pa.

YARWAY REMOTE LIQUID LEVEL INDICATOR

MECHANICAL ENGINEER, experienced in the construction and operation of rotary printing presses. Will assist in design of parts for these machines. Must have knowledge of inks. $6000–$7500. New York, N. Y. W-9887.

MECHANICAL ENGINEER, graduate, who has had about 10 years' testing and development experience, who under general supervision of chief of laboratory, will be responsible for testing and development in the field of mechanical prosthetic appliances. Veteran preferred. $5905. New York, N. Y. W-9889.

PROJECT ENGINEER, 32–50, mechanical graduate, with 10 years' experience in process and equipment development, textiles preferred. Should have ability to assume responsibility for a large project and direct the work of other engineers. Will be responsible for planning and analyzing project, soundness of design, correctness of calculations, meeting time schedules and meeting project-cost estimates. $5200–$7200. Connecticut. W-9901.

CHIEF ENGINEER, 35–45, qualified to act as chief manufacturing engineer of a large multiple plant operating in chemical-process industry, with some experience in manufacturing engineering in the chemical-process-engineering functions. Must be able to develop for approval of the vice-president of manufacturing broad general objectives, policies, and programs covering administration of the chief engineer's department. $15,000–$18,000. Upper New England. W-9911.

SERVICE MANAGER, with several years' experience in servicing and maintaining commercial refrigeration and air-conditioning equipment, preferably York equipment. Must be capable of trouble-shooting any phase of this equipment and managing a group of service men, train new men, etc. Salary open. Florida. W-9941.

PLANT ENGINEER, should be a good mechanical and electrical engineer. Will take charge of all power plant machinery, including development and maintenance of new production machinery and equipment. Salary open. Northeastern Massachusetts. W-9945.

ASSOCIATE PROFESSOR, master's degree, to head up work in industrial engineering. Should be a production man capable of handling such courses as industrial management, time and motion study, and a more general course in industrial engineering. Should have had some experience in industry. $4300 for ten months. Massachusetts. W-9946.

CHIEF ENGINEER AND ASSISTANT SUPERINTENDENT, mechanical graduate, with at least 5 years' metal-stamping and hardware experience, to supervise engineering staff and assist superintendent in plant operations, for manufacturer of hardware and other products. $6000–$8000. Northern New Jersey. W-9951.

MACHINE DESIGNERS, 2, preferably with experience on machine tools for grinding flat surfaces and fixtures, although a good designer on other machines would probably meet the requirements. Age range 40 to 45 years with approximately 20 years' experience in machine design. Southern Wisconsin. Position is permanent. Starting salary $500 per month. R-4500-C.

A.S.M.E. Master-File Information

Please Print — Check Mailing Address

Name ..... (Last — First — Middle)

Home Address ..... ☐ (Street — City — Zone — State)

Name of Employer .....

Address of Employer ..... ☐ (Street — City — Zone — State)

Product or Service .....

Position or Title .....

Notify Headquarters Promptly of Changes

Keep Your A.S.M.E. Records Up to Date

HEADQUARTERS depends on its master membership file for answers to hundreds of inquiries daily pertaining to its members. All other Society records and files are kept up to date through changes processed through it. The listings in future A.S.M.E. Membership Lists will be taken directly from the master file. It is important to you that it lists your latest mailing address and your current business connection.

The mailing form on this page is published for your convenience. You are urged to use it in reporting recent changes.

Your mailing address is important to Headquarters. Please check whether you want your mail sent to home or office address.

Candidates for Membership and Transfer in the A.S.M.E.

THE application of each of the candidates listed below is to be voted on after Dec. 25, 1947, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

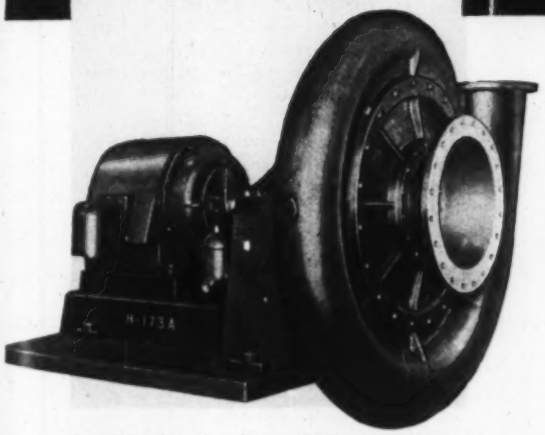
For Fellow, Member, Associate, or Junior

ADDIE, ALBERT NORMAN, Chicago, Ill.
ALPER, LEONARD JEROME, New York, N. Y.
ANDERSON, JOHN B., Jeannette, Pa.
ANDERSON, LORAN BURTON, South Pasadena, Calif.
ANDERSON, PETER D., Detroit, Mich.
ANDERSON, THOMAS BRUCE H., Charleston, W. Va.
ARNOLD, PAUL L., Chattanooga, Tenn. (Rt & T)
BADAMI, F. V., Junagadh (Kathiawar), India
BADE, RICHARD O., Ft. Wayne, Ind.
BALKIND, ROBERT N., Boston, Mass.
BAYER, LAD J., Fairview Village, Ohio
BEISER, W. S., Savannah, Ga.
BIRD, J. DWIGHT, Boston, Mass.
BOGAR, W. H., Arden, Del.
BRICKER, LEO, Brooklyn, N. Y.
BRIEDE, ROBERT P., Chicago, Ill.
BUCKLEY, EDWARD P., Schenectady, N. Y.
BURGOYNE, CALEB BERNARD, State College, Miss. (Rt & T)
BURHARDT, K. W., Detroit, Mich.
CARTER, HENRY G., Savannah, Ga.
CHASE, CORSON WALTER, Oak Park, Ill.
COKYUCEL, NIHAT M., Berkeley, Calif.
CUTTLER SIDNEY S., Baltimore, Md.
DOLIDA, NICHOLAS R., Brooklyn, N. Y.
DORGAN, LEWIS A., New York, N. Y.
DOWNES, MARK S., Canton, Ohio (Rt & T)
DUNCAN, WILLIAM, Philadelphia, Pa.
EDMUND, JOHN R., Emeryville, Calif.
ELLIS, JOHN L., New York, N. Y.
ERIKSSON, SVEN E., Ludvika, Sweden
FINKEL, COLEMAN L., Baltimore, Md.
FORD, RICHARD G., Cincinnati, Ohio
FRITZSCH, T. N., Pittsburgh, Pa. (Rt)
GARDINER, DUNCAN B., Detroit, Mich.

(A.S.M.E. News continued on page 1088)

AIR GOES TO WORK FOR SAFER MINING

(*Photograph by courtesy of Bituminous Coal Institute*)



In 1858, when the Atlantic Cable carried its first message, "Roots" had been producing blowers for four years, since 1854. We're not good because we're old, but old because we're good!

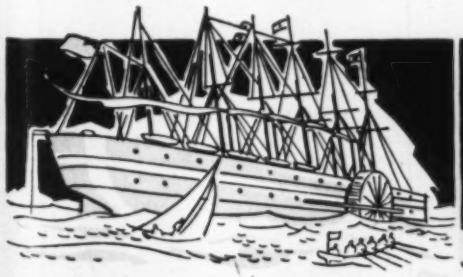
Coal dust in mines is an old hazard problem. Modern practice minimizes danger by blowing rock dust onto walls and roofs, diluting the coal dust and safeguarding against explosions.

The installation pictured uses reliable Roots-Connersville *Rotary Positive* Blowers. These compact, sturdy units have a capacity for long, hard work that especially suits them to such unfavorable conditions.

For many applications, the advanced designs of R-C *Centrifugal* Blowers are more advantageous. Whatever the work to be done, our *dual-ability* to design and build both types enables us to recommend the *right* blower for the specific job.

So, if you have a problem of handling gas or air in any quantity, ask R-C *dual-ability* to help solve it.

ROOTS-CONNERSVILLE BLOWER CORPORATION
712 Michigan Avenue, Connersville, Indiana



ROOTS-CONNERSVILLE
ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS
★ ★ ONE OF THE DRESSER INDUSTRIES ★ ★

GEIGER, CHARLES T., San Diego, Calif.
GIBBS, C. B., Philadelphia, Pa.
GIORDANO, ALBERT J., Phillipsburg, N. J.
GOULDTHROPE, H. W., Erie, Pa.
GRISWOLD, HECTOR C., Summit, N. J.
GUNDER, DWIGHT F., Ithaca, N. Y.
HABER, BERNARD D., Dayton, Ohio
HART, DICK E., Detroit, Mich.
HATCH, FRANK R., San Rafael, Calif.
HAVERLY, C. U., JR., Syracuse, N. Y.
HEIDRMAN, I. L., Cleveland, Ohio
HERR, DONALD LINCOLN, Brooklyn, N. Y.
HOPKINS, JOHN R., Denville, N. J.
JAXTHEIMER, EARL P., Greenville, Pa.
UNKINS, RAYMOND D., Cleveland, Ohio (Rt & T)
KARRER, FELIX, Woodland, Calif.
KELLEY, JOHN I., Philadelphia, Pa.
KENNY, THOMAS J., Philadelphia, Pa.
KIRKPATRICK, MILTON ELDER, JR., New Orleans, La.
KNIGHT, JAMES L., Erie, Pa.
KOCH, JOHN B., Detroit, Mich.
KROEKER, J. DONALD, Portland, Oregon
LANNI, LEONARD, Oak Ridge, Tenn.
LASZLOFFY, A., JR., Los Angeles, Calif.
LAVINGIA, J. P., Khadia, Ahmedabad, India
LOWERS, HORACE R., Columbus, Ohio
MALM, LARS EDVIN, Moline, Ill.
MANN, G. C., Red Rock, Ontario, Can.
MARIS, ARTHUR S., Richmond, Va.
McMULLIN, H. L., Dallas, Texas
McPHERSON, J. A., Wausau, Wis.
METZGER, L. W., Germantown, Philadelphia, Pa.
MORGAN, DAVID W. R., JR., Swarthmore, Pa.
MORRIS, ALEX, Fort Screven, Ga.
MORRIS, JAMES E., Arlington, Va.
MOSSHART, DONALD J., Philadelphia, Pa. (Rt &T)
MUMMERT, JOHN F., Birmingham, Ala.
NADHERNY, R. J., Chicago, Ill.
NEUBERGER, E. F., Dover, N. J.
PETERSEN, L., LaGrange, Ill.
PETTICAN, A. H., Cape Town, South Africa
PHARES, J. RICHARD, Manhattan Beach, Calif.
POOL, CHARLES M., Los Angeles, Calif.
POTTER, E. F., Schenectady, N. Y.
POWERS, LEWIS R., Merced, Calif.
PRESTIN, MICHAEL H., Connellsville, Pa.
PURIFOY, BOYD F., Tulsa, Okla.
RALSTON, ROY T., Greensburg, Pa.
REIBEL, SIDNEY, Huntington Woods, Mich.
ROBBINS, JOSEPH E., Brooklyn, N. Y.
ROBINSON, JAMES, Detroit, Mich.
ROWAN, A. T., New Orleans, La.
RYAN, THOMAS J., Detroit, Mich.
SCHMIDT, HENRY W., Wilmette, Ill.
SCHREIBER, JOHN H., St. Louis, Mo.
SCHWARTZ, ROBERT M., Mount Freedom, N. J.
SEN, D. K., Louisville, Ky.
SEN, GOPAL C., Ypsilanti, Mich.
SHOEMAKER, WALTER P., San Gabriel, Calif.
SLOCUM, WALTER W., Ridgewood, N. J. (Rt & T)
SMITH, EARL ROSS, Camden, N. J.
SOUTHCOTT, L. C., London, S. W. 1, England
STAPLES, PAUL S., JR., Rye, N. Y.
STEINWAY, THEODORE D., Long Island City, N. Y.
STINSON, WILLIAM H., Prospect Park, Pa.
STOCKARD, R. H., Kingston, R. I.
STREICHER, WILLIAM HAROLD, Niagara Falls, N. Y.
SYKES, F., HUNTLEYS Pt., N. S. W., Australia
TRESCHOW, K. F., Pittsburgh, Pa. (Rt)
UHL, T. J., JR., Dallas, Texas
WALTON, CHARLES W., 3RD, Ridgewood, N. J.
WARNER, DONALD S., Charleston, W. Va.
WASSERBAUER, A., Prague VIII-Liben, Czechoslovakia
WEBER, ARTHUR W., Corning, N. Y. (Rt & T)
WIEDMANN, ERNST, Milwaukee, Wis.
WILLI, RICHARD B., Norristown, Pa. (Rt & T)
WILLIAMS, ROGER G., Minneapolis, Minn.
WILSON, FRANCIS D., Westfield, N. J.
WILSON, JOHN, New Dorp, S. I., N. Y.,
WOLSDORF, CARL C., Cincinnati, Ohio
WORTLEY, ROBERT, South Amboy, N. J.
WRIGHT, M. BIRNEY, Morgantown, W. Va.

CHANGE IN GRADING

Transfers to Fellow

ALDWORTH, EDWARD H., Scarsdale, N. Y.
WIKANDER, OSCAR R., Pittsburgh, Pa.

Transfers to Member

BACHA, CHARLES P., METUCHEN, N. J.
BARDOFF, LOUIS F., San Francisco, Calif.
BARNES, WILLIAM J., Swarthmore, Pa.
BUCKHOLTZ, IRA E., Menlo Park, Calif.
CIZEK, ALBERT W., JR., East Elmhurst, N. Y.
COFFIN, LOUIS F., JR., Wellesley Hills, Mass.
COMSTOCK, J. F., Murray, Neb.
DEMATTEO, A. J., Plainfield, N. J.
EUVRARD, LEROY, New York, N. Y.
FRANCIS, JOSEPH S., Chicago, Ill.
GABLA, N. F., Karachi, India
GARRETT, ELMER E., Freeport, N. Y.
GEORGE EVERETT D., Cuyahoga Falls Ohio
GLASS, JOSEPH E., Louisville, Ky.
GONGWER, CALVIN A., Azusa, Calif.
GOODWIN, RICHER M., Philadelphia, Pa.
GRANT, RAY M., Chicago, Ill.
HADNOT, LUKE R., SR., Portland, Ore.
HALLENBECK, THOMAS L., Toledo, Ohio
HAMANN, JOHN R., Detroit, Mich.
IMMEL, JOHN R., San Marino, Calif.
JOHNSON, E. SIGURD, Salem, Va.
LENNIE, A. M., Wichita, Kan.
LOCKETT, R. P., JR., New Orleans, La.
MOORE, LEONARD S., Aberdeen Proving Ground, Md.
MUSCHETT, WILBERY RAMSEY, W. Englewood, N. J.
NORVILLE, RICHARD G., Pittsburgh, Pa.
PATE, SAMUEL G., JR., Birmingham, Ala.
PUTT, J. WILLIAM, Hamburg, Pa.
REED, F. EVERETT, Belmont, Mass.
RICHARDS, THOMAS E., JR., Lancaster, Ohio
ROBERTSON, B. P., Houston, Texas
SCHLAGE, ERNEST L., Burlingame, Calif.
WEAVER, EARL MARSHALL, Houston, Texas
WELLER, ARTHUR C., Scarsdale, N. Y.
WILLIAMSON, W. R., Hartford, Conn.
WITTIG, FREDERICK E., Houghton, Mich.
WRIGHT, ROBERT E., Kirkwood, Mo.

Transfers from Student Member to Junior....200

Necrology

THE deaths of the following members have recently been reported to headquarters:

BOORAEM, J. FRANCIS, October 9, 1947
CRANE, HOWARD P., October 8, 1947
ENNIS, WILLIAM D., October 14, 1947
GIBSON, JAMES E., October 15, 1947
HARDY, GEORGE F., October 2, 1947
HENDERSON, CURTIS L., August, 1947
INGALLS, C. H., September 20, 1947
JAKOBSSON, GUSTAV H., October, 1947
MERL, MILTON F., September 28, 1947
PEARCE, SIR (STANDEN) LEONARD, October 20, 1947
ROGERS, BENJAMIN F., October 16, 1947
ROYLE, VERNON E., September 19, 1947
SNOWDEN, H. J., August 22, 1947
WEBSTER, HARRY D., September 24, 1947

A.S.M.E. Transactions for November, 1947

THE November, 1947, issue of Transactions of the A.S.M.E. contains the following papers:

Coefficients of Discharge of Sharp-Edged Concentric Orifices in Commercial 2-In., 3-In., and 4-In. Pipes for Low Reynolds Numbers Using Flange Taps, by E. E. Ambrosius and L. K. Spink

A Simplified Method for the Design of Vibration-Isolating Suspensions, by R. C. Lewis and Karl Unholtz

Electrical Snap-Action Temperature Controls for Aircraft, by J. R. Campbell

Thermal Anti-Icing Survey on Mt. Washington, by A. G. Guibert

Bending Rigidity and Column Strength of Thin Sections, by P. E. Sandorff

Heat Requirements for Instruments and Airfoils During Icing Storms on Mt. Washington, by V. J. Schaefer

Liquid-Propellant Rocket Power Plants, by M. J. Zucrow

Development and Testing of a Gas-Turbine Combustor, by A. E. Hershey

Fatigue Tests of Welding Elbows and Comparable Double-Mitre Bends, by A. R. C. Markl

Centrifugal Governor in Elevator Service, by F. Hymans

Experimental Study of Cylindrical Grinding, by R. E. McKee, R. S. Moore, and O. W. Boston

Torsional Stress Analysis of Twist-Drill Sections by Membrane Analogy, by E. T. P. Neubauer and O. W. Boston

Some Effects of Pressure Loss on the Open-Cycle Gas-Turbine Power Plant, by J. I. Yellott and E. F. Lype

Internal-Shoe Clutches and Brakes, by O. Von Mehren

Semiuniversal Toothed Couplings, by Ernest Wildhaber

Explanation of Longitudinal Shrinkage of Wood Based on Interconnected Chain-Molecule Concept of Cell-Wall Structure, by R. A. Cockrell

Damping of Textile-Mill Movement by Frahm System, by C. E. Crede

Heat Transfer to Molten Metals, by R. C. Martinelli

Temperature Distribution in Cylinder Heated by Point Source Moving Along Its Axis, by D. Rosenthal and R. H. Cameron

VICKERS Variable Speed HYDRAULIC TRANSMISSION

1/2 Horsepower

PRICE

$75.00

Here is a compact, sturdy, variable speed hydraulic transmission for machinery drive. Any speed from zero to 1750 rpm—*in either direction* can be obtained without reversing the driving motor.

Effortless finger tip speed adjustment over the entire range is obtained by the handwheel control and the selected speed remains constant. A hydraulic servo control mechanism is also available. The full output torque is available throughout the speed range and the built-in automatic overload protection permits stalling without causing damage.

The Vickers hydraulic transmission is automatically pressure lubricated by the power transmitting medium (oil) for long and trouble-free operation.

Contact the Vickers Sales Engineering and Service Office nearest you for complete information.

ASK FOR BULLETIN No. 47-40

VICKERS Incorporated
DIVISION OF THE SPERRY CORPORATION
1309 OAKMAN BOULEVARD • DETROIT 32, MICHIGAN

Sales Engineering and Service Offices: ATLANTA CHICAGO • CINCINNATI • CLEVELAND • DETROIT LOS ANGELES • NEWARK • PHILADELPHIA • ROCKFORD • ROCHESTER • SEATTLE • ST. LOUIS TULSA • WASHINGTON • WORCESTER

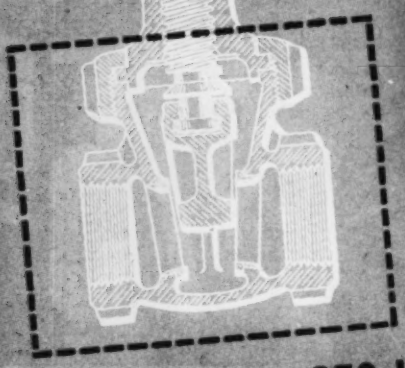
ENGINEERS AND BUILDERS O[illegible] 1921

JENKINS GIVES YOU

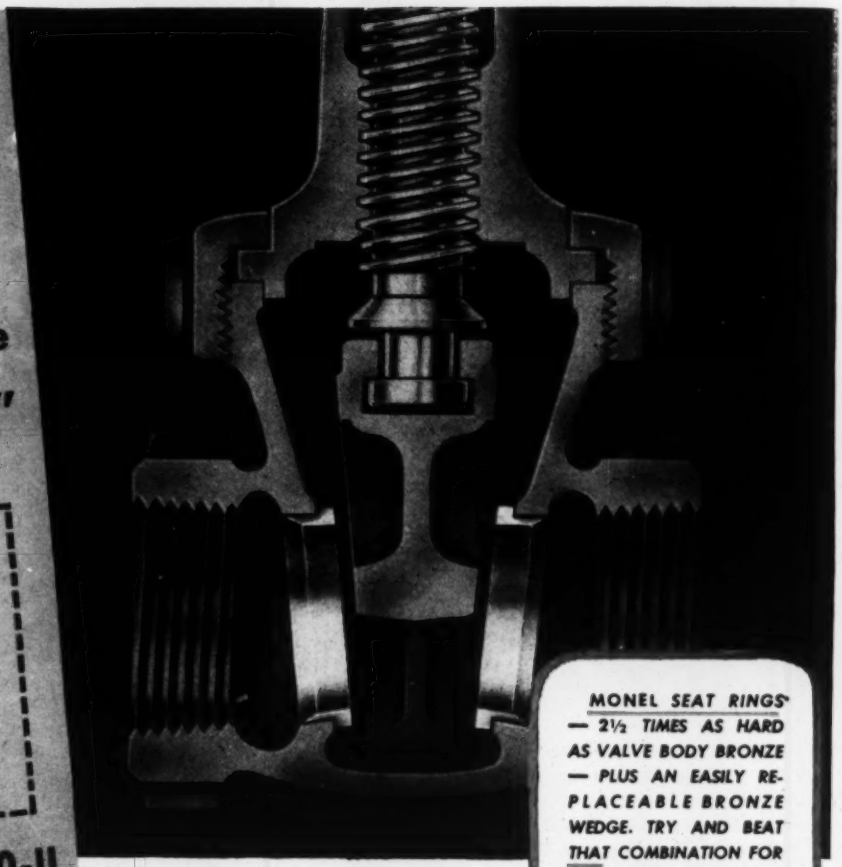
Super Toughness

in the

"TROUBLE ZONE"



in the NEW FIG. 270-U
200 lb. BRONZE GATE



MONEL SEAT RINGS — 2½ TIMES AS HARD AS VALVE BODY BRONZE — PLUS AN EASILY REPLACEABLE BRONZE WEDGE. TRY AND BEAT THAT COMBINATION FOR LONG LIFE, LOW MAINTENANCE!

Plus....

IN the NEW Fig. 270-U Bronze Gate Valve, Jenkins engineers give you a practical design to checkmate trouble in the "trouble zone" — and cut maintenance to a new low.

Wear affects only the most accessible part — the bronze wedge — which can be replaced simply by slipping it off the stem and slipping on a new one. The seat rings, expanded in the body, are super-tough MONEL, for lifetime durability. Convincing tests, in toughest service, prove it the best seating combination to beat wear, reduce care.

Get complete details of this NEW Jenkins Fig. 270-U. See why it's your best buy in a 200 lb. Bronze Gate, especially for unusually severe conditions, such as in oil refineries, chemical, food, and rubber plants.

LARGE SPINDLE THREADS—Plenty of large diameter, sturdy threads reduce wear to a minimum, insure easy operation.

EXCEPTIONALLY RUGGED BODY, BONNET, AND BONNET RING — Withstand rough usage, shocks and hydraulic pressure far beyond rating.

DEEP STUFFING BOX — MORE PACKING—Keeps packing tight around spindle with less friction, permits spindle to be turned with less effort.

NEW FOLDER — Describes many other exclusive features that mean extra years of low-cost performance.

WRITE FOR THIS FOLDER. It describes the Fig. 270-U and many other popular Jenkins Bronze Gate Valves. Or, ask your Jenkins Distributor.

MAIL THE COUPON TODAY

LOOK FOR THIS JENKINS TRADE MARK DIAMOND MARK

SINCE Jenkins Bros 1864

JENKINS VALVES

Types, Sizes, Pressures, Metals for Every Need

JENKINS BROS.,
80 White St., New York 13, N. Y.
Send Bronze Gate Valve Folder.
NAME.....
COMPANY.....
ADDRESS.....

• Keep Informed . . .

Announcements in this section are about current advertisers in MECHANICAL ENGINEERING and A.S.M.E. MECHANICAL CATALOG.

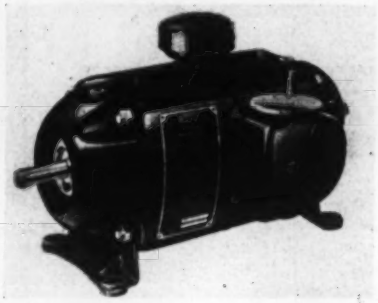
All items are supplied by these advertisers and the section is restricted to them.

• NEW EQUIPMENT
• BUSINESS CHANGES
• LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

• NEW EQUIPMENT

Vickers Variable Speed HydraulicTransmission



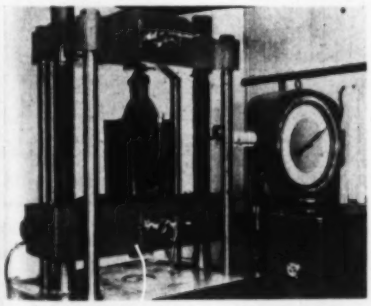
Vickers Inc., 1500 Oakman Boulevard, Detroit, Mich., announces the development of a new, variable speed hydraulic transmission for fractional horse power machinery drives.

Features of the new Vickers transmission include smooth and stepless speed adjustment from zero to maximum output RPM in either direction of rotation. Full and constant torque power characteristics are maintained throughout the entire speed range. The input shaft may be driven in either direction without mechanical change. Also, the unit may be stalled without damage as it is equipped with automatic overload protection.

The Vickers TR2-R13F13 Variable Speed Hydraulic Transmission is rated at ½ HP, continuous duty. Effortless finger-tip speed adjustment over the complete range is obtained by either handwheel or servo control.

For complete information, write for Bulletin 47-40.

High-Temperature Pipe Clamp

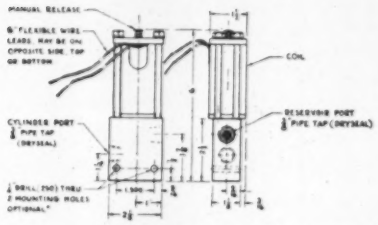


In the field of high-temperature piping it has been necessary to use clamps that were of special design and custom-made. Grinnell Co., Inc., Providence, R. I., has undertaken to supply the demand for high-temperature pipe clamps in seven sizes from 4 in. through 16 in. with a commercial clamp made of Chrome Vanadium Steel as a one-piece drop forging and equipped with a U Bolt of the same material. These are expected to meet the major portion of high-temperature pipe clamp requirements at temperatures up to 1000° F., without a high cost penalty.

Load ratings of the clamps for the various pipe sizes have been established after an exhaustive series of tensile strength tests in which the clamps were pulled to destruction to determine their ultimate breaking strengths. On the basis of the results of these tests, conservative maximum recommended load ratings have been established for their use on piping at various elevated temperatures in accordance with the Code for Pressure Piping.

The accompanying photograph shows a 14 in. Figure 224 pipe clamp set up in a tensile testing machine prior to being pulled to destruction at 66,300 pounds load.

New Solenoid Valve



A new Solenoid Valve has been perfected by Waterman Engineering Co., 721 Custer Ave., Evanston, Illinois. It is an inexpensive, compactly-built unit for all hydraulic systems, or for the handling of any non-corrosive fluids. It has a maximum working pressure of 3000 P. S. I., and electrical requirements of 6, 12, 24, or 36 volts D. C., with low current consumption of 2.3 amperes at 12 volts. It locks the fluid in one direction and admits free flowing in the other direction. This valve is also available with integral flow rate regulation.

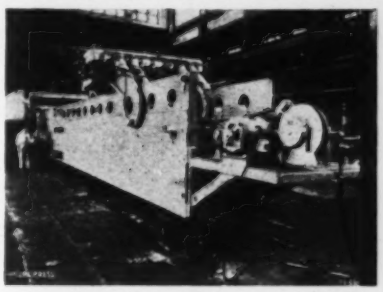
Yoke Arm for Self-Propelled Earth-Mover Welded by the "Unionmelt" Process

The type UE welding head, with a special adaption for carriage mounting, is making one of four corner welds required to complete a yoke arm fabricated from four cut steel pieces. The parts are first assembled and held together by manual tack welds.

With the "Unionmelt" welding process, this manufacturer fabricates a variety of parts used in the construction of earth-moving equipment.

In the left foreground is the electronic voltage control and also the vacuum recovery unit, which picks up the granular welding composition that is not fused during the welding.

Large Hydraulic Plate Stretcher-Leveller of New Design



A Stretcher-Leveller of special design, believed to be the largest ever made, was built by Hydropress, Inc., New York. The machine which is shown in the picture after shop erection, is of the self-contained oil hydraulic type, has a capacity of 825 tons and is adapted to accommodate plates or sheets up to 100″ wide. The maximum length of the plates is 33′ and the minimum length 7′. Two gripheads are provided of which one is actuated by the hydraulic stretching cylinder, while the position of the other one is adjustable to compensate for the varying length of the plates. Operation of the machine is effected by remote control from the operating panel. Pressure adjustment over a wide range is provided for handling thinner and narrower plates at the accurate required pressure.

Stainless-Clad Steel

Workmen put finishing touches on Lukens Stainless-Clad Steel inset in sidewalk at entrance to Main Office building of Lukens Steel Co., Coatesville, Pa. The letters, 10 inches high, were sawed in a plant of By-Products Steel Corporation, a Lukens division, from 20% Stainless-Clad Steel Plate. A light layer of stainless steel is bonded uniformly and permanently by hot rolling to a

Continued on page 43

PEOPLE DON'T STANDARDIZE ON "SUBSTITUTES"

For nearly 15 years, molybdenum high speed steels have *proved on their own merits* that they are *superior* steels. Long before World War II, during the war, and up to the present moment, these steels have done *more* work for *less* money.

Molybdenum high speed tool steels, for instance, are not only tougher, and do more work per job, but are consistently cheaper than 18-4-1. In addition, they are from 6% to 9% less dense, so more tools may be made from the same gross weight of steel.*

Get the facts about what molybdenum high speed steels can do for you.

**FREE BOOKLET on molybdenum high speed steels gives proof of these statements. Write for it.*

MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

• Keep Informed

backing plate of steel to make a Lukens Stainless-Clad Steel plate. The corrosion resistance and product protection of stainless steel thus are available at appreciable savings in cost over that of the metal in its solid form.

Lukens recently started the manufacture of Stainless-Clad Steel as the fourth in its group which includes Nickel-Clad, Inconel-Clad and Monel-Clad Steel. No separation of the cladding material from the backing plate will take place under normal conditions of temperature change, pressure, vacuum or mechanical shock.

The "1810" in the inset commemorates the year of the founding of "The Brandywine Iron Works and Nail Factory"—a predecessor of Lukens Steel Company.

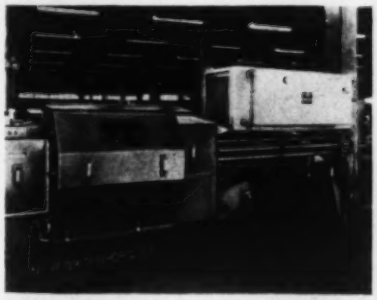
Mercury-Actuated Clutch

The installation of a mercury-actuated clutch developed by Mercury Clutch Division of Automatic Products Corp., Canton, Ohio, results in more efficient operation of farming and lumbering machinery such as portable saws, conveyors, mowers, tractors, portable grain elevators, cream separators, water systems, and many other installations using gasoline engines and electric motors.

This new automatic clutch, installed on a power saw, for instance, automatically engages when the throttle is open and disengages when the throttle is closed, or if the saw blade pinches. The clutch permits the engine to attain full speed before the saw is engaged. Its design incorporates a "time delay" factor which retards the engagement for a second or more, long enough for the engine to come up to full speed before any load is applied. The manufacturer has developed standard clutches for all types of gasoline engines and for electric motors up to 15 H. P.

Coolant Temperature Control Unit

Niagara Blower Co. has produced a Coolant Temperature Control Unit for application to New Britain-Gridley Automatic Screw Machines. The new unit increases production by eliminating warm-up operations and subsequent tool adjustments as well as preventing variations in the machine work caused by temperatures rising during operating periods.



When the screw machine is operating, the coolant is kept at a pre-determined temperature by the constant evaporation of moisture

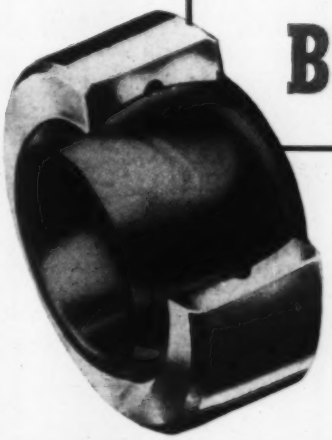
Continued on page 44

THE NEW

HALFCO

SPHERICAL CONTACT SELF-ALIGNING BEARING

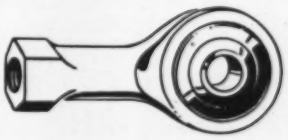
U.S. AND FOREIGN PATENTS PENDING



Here's a new, two-piece, self-aligning bearing. It consists of a heat-treated, hard-chrome-plated, highly-polished steel ball, around which an outer race is integrally formed. This unique design permits the greatest possible mis-alignment. Full *spherical surface* contact allows extremely heavy loading—resists both axial and radial forces.

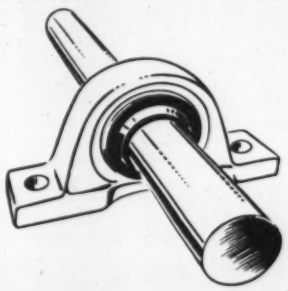
Here are a few of the countless applications for HALFCO Bearings—

AS A ROD END BEARING



The self-aligning and shock resisting characteristics of HALFCO Bearings make them ideal for mechanical linkage systems. They may be used as ball joints, rod ends on actuating cylinders, or on linkages to accommodate motion in more than one plane.

AS A ROTATION BEARING OR STATIC, SELF-ALIGNING BUSHING



HALFCO Bearings have wide applications as rotation bearings for high load, slow speed installations. The self-aligning and axial thrust capacity features make them far superior to plain journal bearings for certain applications. A 360 degree oil groove assures positive lubrication.

The extremely high permissible loading on the HALFCO Bearings makes them well suited for static, self-aligning bushing service. HALFCO units are also used as engine mount attachment bushings where heavy loading and easy removal of supported unit are important.

ADEL

The simplicity of design permits low cost, volume production methods to be utilized. HALFCO Bearings are fabricated in a wide variety of materials, types and sizes. Consider them for your application. Write for catalog containing complete specifications.

Please address inquiries to

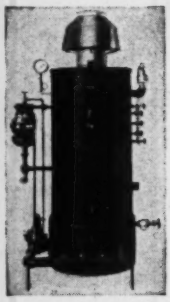
10767 Van Owen Street, Burbank, California.

ADEL PRECISION PRODUCTS CORP.

BURBANK, CALIFORNIA ★ HUNTINGTON, WEST VIRGINIA

Manufacturers of: Aircraft Hydraulic Systems • Marine & Industrial ISOdraulic Controls • Halfco Self-Aligning Bearings • Line Support Clips & Blocks Industrial Hydraulic Equipment • Aircraft Valves • Industrial Valves

Engineered STEAM



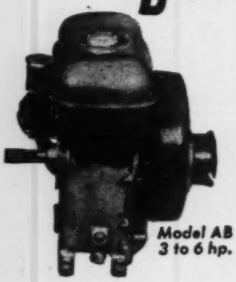
A COMPACT SELF-CONTAINED and CUSTOM-BUILT STEAM SOURCE FOR YOUR JOB

The KANE Boiler, built to A. S. M. E. specifications, in sizes 1 to 30 H. P.

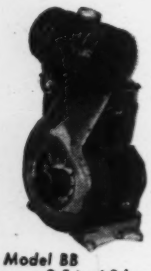
Investigate *Engineered Steam.* It's steam *where* you need it, *when* you need it. . . with minimum supervision and maintenance. It's components include: the study and solution of your steam requirements; the KANE Boiler, properly sized and constructed, to fit *your* needs; the Necessary Controls to provide constant steam pressure and temperature; the M-K-O Automatic Boiler Feed to maintain the water level for highest boiler efficiency; and the Engineering and Manufacturing Experience to insure economical and trouble-free operation.

MEARS-KANE-OFELDT INC.
1903-1915 EAST HAGERT STREET, PHILADELPHIA 25, PA.
FOUR DECADES OF AUTOMATIC GAS-FIRED BOILER MANUFACTURING EXPERIENCE

BEE-LINE ENGINES



Model AB 3 to 6 hp.



Model BB 2.5 to 4.3 hp.

In Volume Production

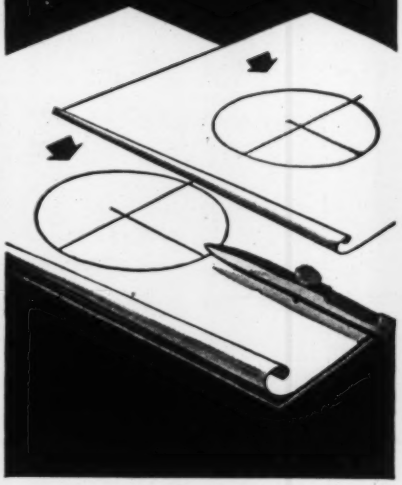
Prompt Delivery

These 4-cycle, air-cooled gasoline engines are thoroughly service-proved in many applications. Light weight, compact design, and wide power range mean ready adaptability to many types of equipment and powering problems. Backed by 28 years of engine building experience, including manufacture of the famous Kinner aircraft engines.

Gladden Products CORP.

635 W. Colorado Blvd., Glendale 4, Calif.

Tracing cloth that defies time



● The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

IMPERIAL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

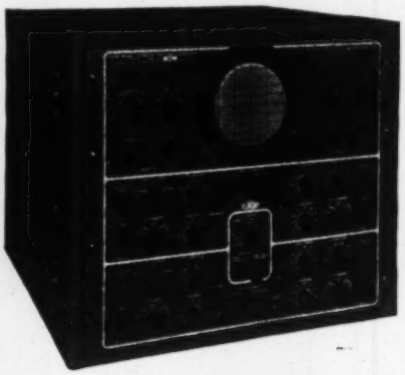
• Keep Informed

on the outside of tubes thru which the hot coolant oil is flowing. This method removes 1000 BTU per lb. of water evaporated. When the machine is stopped, a fall in the coolant temperature is prevented by the automatic operation of an electric element, which is also used for pre-heating after a longer shut-down period. Whether the machine is running at high speed, or stopped, or remains idle over night, the temperature of the coolant is always within 2 or 3 degrees of a predetermined point, effectively preventing harmful contraction or expansion of working parts.

The unit can be adapted to all multiple spindle automatics. It is manufactured by Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y., and installed by New Britain-Gridley Division of the New Britain Machine Co., New Britain, Conn.

Dual-Beam Cathode-Ray Oscillograph

A new Type 279 dual-beam cathode-ray oscillograph is announced by Allen B. Du Mont Labs., Inc., Instrument Division, Clifton, N. J. Outstanding in this instrument is the two-gun Type 5SP-A cathode-ray tube containing two separate and completely independent electron guns. The Type 279 oscillograph provides each gun with separate controls for intensity, focus, and X-, Y- and Z-axis modulations.



Identical linear time-bases are provided for each beam, the sweep generators having continuous sweep frequencies of 2 to 30,000 cps. Single sweep is also available for each beam, with automatic beam control to extinguish the spot except during the active sweep time. Provision is also made to apply one of the time-base generators to both sets of horizontal deflection plates simultaneously, thereby to study and compare related phenomena on the same time-base. Correction circuits assure exact superpositioning of both traces for this type of operation.

Balanced deflection amplifiers are used for each of the X- and Y-deflection systems. The response of the Y-amplifiers is flat to d.c. and is 3 db. down at 200 kc. The response of the X-amplifiers is flat to d.c. and is 3 db. down at 150 kc. The deflection factor of all amplifiers is approximately 1 v. dc/in. A built-in voltage calibrator can be switched into either Y-amplifier at any time. For this operation there is no need to disconnect signals. Capacitatively-coupled connections may be made directly to the deflection plates.

The Type 5SP-A dual-beam cathode-ray tube employed in the Type 279 oscillograph is operated at a total accelerating potential of 4500 volts to provide a picture of high brightness. The brilliance of the trace and the automatic control of the beam are features ideally suited for photographic work or observation of single transients of relatively high writing rates. For photographic application, the Type 279 is so designed that it

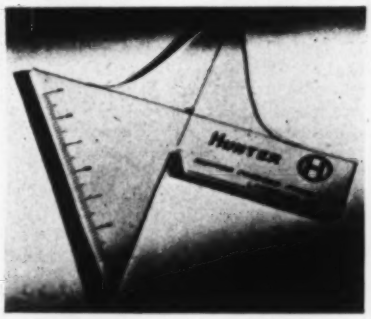
• Keep Informed

may quite readily be used with both the Du Mont Types 271-A and 314 oscillograph record cameras.

This instrument is housed in a gray-wrinkle, rack-type cabinet. Carrying handles are provided on each side of the cabinet. A standard rack panel is used so that the instrument may be removed from its cabinet and mounted in a standard 19″ relay rack. A dust cover is provided for rack mounting.

A power source of 115/230 volts, 50–60 cycles, operates the instrument. Power consumption is 300 watts. Overall dimensions are: $22^{5}/_{8}$″ w., $17^{1}/_{2}$″ h., $22^{1}/_{8}$″ d. Weight is 125 lbs.

New Instrument Aids Statisticians, Inspectors, Quality Control Engineers



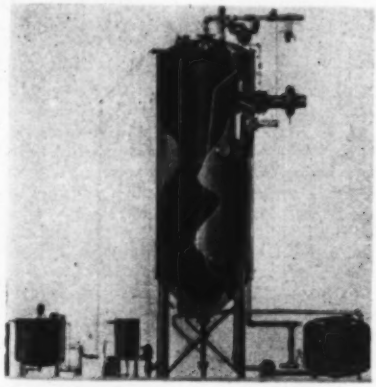
Anyone interested in analyzing the frequency distribution of any product characteristic such as length, weight, diameter, strength, test values, etc., will want one or more of a new instrument now available.

This new instrument is a combination curve, scale and square, made from a laminated transparent plastic. It was developed by the Hunter Pressed Steel Co., Lansdale, Penna., for use in conjunction with their own statistical methods in quality control.

By following a set of instructions supplied with the instrument the operator can quickly picture product distribution in scale relation to specified limits.

The price of $3.00 includes 9 Data Sheets of Instruction and examples of use.

Hot-Process Conditioned Water For High Pressure Boilers



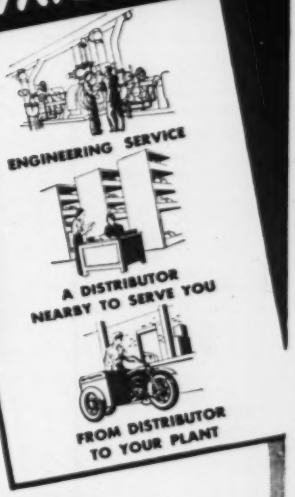
For greater steam plant efficiency the tendency over a number of years has been toward higher boiler operating pressures. This has high-lighted four important requirements for satisfactory boiler feed-water which, in general, seem best obtainable with the hot-process type of water conditioning equipment.

1. Zero Hardness: Zero hardness is required to completely eliminate sludge and

Continued on page 48

Relied upon
BY VALVE MAINTENANCE MEN EVERYWHERE . . .
LUNKENHEIMER DISTRIBUTORS

RENDER A SERVICE THAT IS ESSENTIAL—A VITAL LINK IN THE CHAIN OF INDUSTRIAL PRODUCTION



Located in principal industrial centers, Lunkenheimer Distributors provide direct, readily accessible, time and money-saving service throughout the nation.

In addition to supplying high quality, long life Lunkenheimer Valves, they render valuable aid to maintenance men in the solution of both operating and maintenance problems.

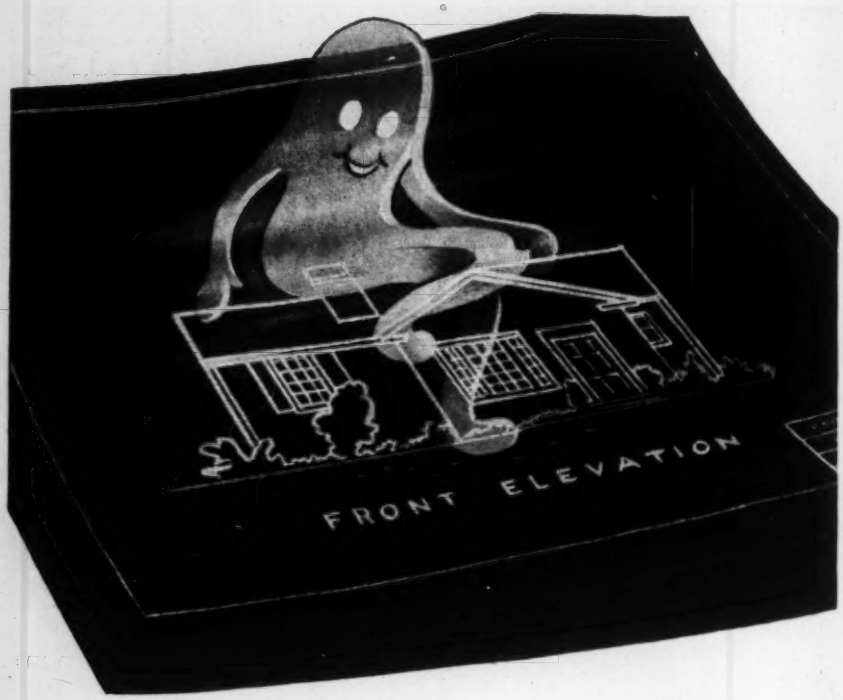
This service isn't new . . . Lunkenheimer Distributors have been providing it for many years in the past, and will continue doing so in the future.

For this Distributor set-up is a basic, permanent part of the Lunkenheimer way—the *better service* way.

Remember—you can *always* depend on your nearby Lunkenheimer Distributor for expert, willing assistance in any problem or difficulty involving valve maintenance or operation. Call on him!

The Lunkenheimer Co., Cincinnati 14, Ohio. New York 13, Chicago 6, Boston 10, Philadelphia 34, Export Department: 318-322 Hudson St., New York 13, N. Y.

LUNKENHEIMER VALVES



The Ghost In Rev. 4

● And it was such a beautiful tracing when it first left the board – but look at the prints now, after that last revision . . . a nice big "ghost" firmly astride the front elevation. Moral . . . don't use inferior tracing cloth.

If this tracing had been on Arkwright, Rev. 4 would have produced prints just as sharp as the day a tracer first initialed it . . . because Arkwright's special mechanical process *prevents* "ghosts". This oil, wax and soap-free method of manufacture builds the translucency *all the way* through. Arkwright cloths *can't* discolor, grow brittle with age.

See for yourself how much better Arkwright is. Send for free working samples. Arkwright is sold by leading drawing material dealers everywhere. Arkwright Finishing Company, Providence, R. I.

All Arkwright Tracing Cloths have these 6 important advantages

1 *Erasures re-ink without "feathering"*
2 *Prints are always sharp and clean*
3 *Tracings never discolor or become brittle*
4 *No surface oils, soaps or waxes to dry out*
5 *No pinholes or thick threads*
6 *Mechanical processing creates permanent transparency*

Arkwright
TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 25 YEARS

• Keep Informed

scale formation in the boiler. This means reduction considerably below the indication of so called "zero hardness" by the soap test. With low hardness supplies having less than 50 ppm of hardness, this can be accomplished by using phosphate and caustic soda as the reagents. With hard water supplies a two-stage softener utilizing cheaper lime and soda ash as the initial treatment followed by phosphate to precipitate the residual hardness externally is generally recommended.

2. Low Total Solids: Water having a low concentration of total solids has always been a requirement of properly prepared boiler feedwater. The goal is to provide a makeup water that approaches distilled water as nearly as is economically possible. Low total solids are desirable to minimize boiler blowoff loss and also to reduce carryover with the steam and the resultant erosion and deposits in steam-using equipment.

3. Low Concentrations of Silica: Since all waters contain silica, often in a quantity that would bring about a prohibitive concentration of silica in the boiler, much attention is now being directed toward its reduction. Silica, even in low concentrations, is apt to volatilize, be carried over with the steam, and solidify on turbine blades causing loss of capacity and efficiency. Even good waters contain a silica concentration of approximately 5 ppm, and, if a plant is designed on the basis of 5% or 10% blowdown, the concentration of the silica in the boiler will be 20 or 10 times concentrating to an extent of 100 ppm or 50 ppm. The removal of silica in the hot process softener is accomplished by coagulation and precipitation using magnesium salts, either initially present as hardness in the raw water or added for the specific purpose. Recirculation of the precipitated sludge from the accumulation in the sludge cone makes maximum economical use of the reagents.

4. Low and Controllable Alkalinities: Although it is very common for low pressure boilers to operate with boiler alkalinities of 300 to 1000 ppm, the alkalinities permitted in high pressure steam generators are ordinarily limited to 150 ppm or even less. This is desirable because low alkalinities produce a sufficiently high pH value to protect the boilers against corrosion; any increase in alkalinity over that necessary to prevent corrosion simply adds to the total solids, increases the blowdown schedule, and is likely to increase the carryover tendencies of the boiler concentrate.

To meet these objectives there are a number of general types of equipment available which, when properly selected and coordinated, will produce a satisfactory water supply and may even approach distilled water under some conditions. All of the required chemical properties of a boiler feedwater should be obtained with minimum investment in equipment and cost of chemical treatment, including supervision of operation.

Descriptive literature is available on the Hot Process Type of Water Conditioning Equipment made by Cochrane Corp., 3142 North 17th Street, Philadelphia, Pa.

New G-E Tri-Clad Motors Feature Stepless Speed Adjustment

A new line of Tri-Clad brush-shifting adjustable-speed induction motors, Type ACA, has been announced by the Motor Division of the General Electric Co. Available in ratings from 3 to 50 hp (220, 440, and 550 volts), the new motor features stepless speed adjustment over a 3/1 ratio by simply turning a dial. The entire unit, with the exception of the starter control, is self-contained in a housing only a little larger than that for a constant-speed motor of comparable rating.

• Keep Informed

Remote speed control can be accomplished by use of a flexible cable shaft up to 10 ft away from the motor. For complete remote control, a small pilot motor can be used to drive the speed control mechanism. Applications include driving textile machinery, draft fans, stokers, small paper machines, wire drawing machines, laundry flat-work ironers, dough mixers, cement kilns, stamping presses and pumps.

Uniform cooling with low intake velocity is provided by double-end ventilation. Necessary over-load protection and limit switches to insure proper starting are built into the motor. The standard frames (225 to 505) have NEMA mounting dimensions. For resistance to oil and heat aging, Formex wire stator windings are used. A cast-iron bearing enclosure affords protection from moisture, dust, and dirt.

The motor is rated on a constant torque basis. It will carry full-load torque at rated current and frequency without exceeding a temperature rise of 40 C on high speed or 50 C on low speed, measured by a thermometer on the windings. Power factor is high when the motor is running at high speed. At synchronous speed, it is about the same as with a squirrel cage induction motor of similar rating.

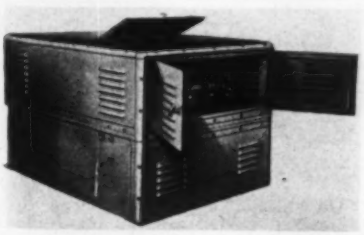
For intermittent use, speeds below minimum rated may be obtained by adding secondary resistance. Plugging is possible by the same means. The motor is reversible for short periods of time by reversing two power leads.

Convenient inspection plates may be removed for inspection of brushes and brush-shifting mechanism. The motor may be greased while in operation. All necessary inspections may be performed without removing any operating parts.

Additional information is given in Bulletin GEA-4854.

Custom Built Hydraulic Power Units

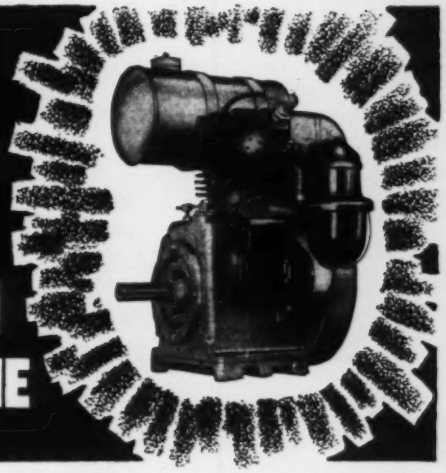
Custom built hydraulic power units designed for special installation requirements are offered to the industrial machinery field by Vickers Inc., 1500 Oakman Boulevard, Detroit, Mich.



The new Vickers "packaged" power unit can be designed and built to include all of the necessary valves, pumps, oil reservoirs, intermediate piping, motors, air cleaners, etc., in one self-contained unit. Hydraulic

Continued on page 48

Now you can get Immediate Delivery on this 2 to 4 Hp. WISCONSIN *Air-Cooled* ENGINE



Tremendously increased production capacity for our smaller sizes now enables us to offer our Models AB and AK engines (2 to 4 Hp) for immediate delivery — in volume to manufacturers of power-operated equipment, or through authorized distributors and dealers on individual purchases.

These are heavy-duty, 4-cycle single cylinder engines that carry "Most Hp. Hours" service ratings. Equipped with tapered roller bearings at BOTH ends of the drop-forged, dynamically balanced crankshaft for long life and protection against bearing failure; high tension outside magneto with impulse coupling for quick, easy starting in any weather; pump-circulated constant level splash lubrication system (no grease cups or oil fittings). Net weight: Model AB, 76 lbs.; Model AK, 77 lbs. Speed range: Model AB, 1600-2600 rpm; Model AK, 1600-2400 rpm.

●

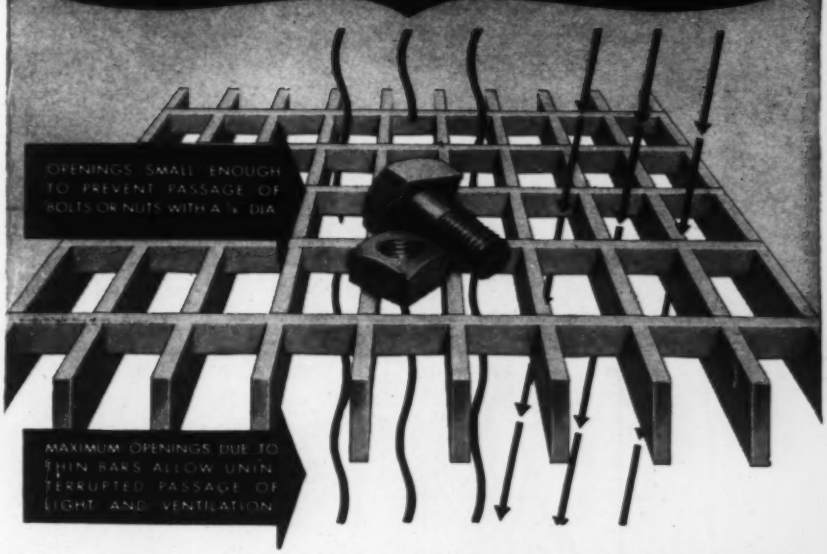
For further engineering data, prices, etc., write, phone or wire . . . or see your authorized Wisconsin Engine distributor or dealer.

WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 14, WISCONSIN

This is TRI-LOK OPEN STEEL FLOORING


OPENINGS SMALL ENOUGH TO PREVENT PASSAGE OF BOLTS OR NUTS WITH A ½ DIA
MAXIMUM OPENINGS DUE TO THIN BARS ALLOW UNINTERRUPTED PASSAGE OF LIGHT AND VENTILATION

Extra strong construction — openings closely spaced — available in rectangular, diagonal and U shapes — with Safety Steps. Ask for Bulletin 1140.

DRAVO CORPORATION, NATIONAL DEPARTMENT
1103 PITT BANK BLDG., PITTSBURGH 22, PA.
(Distributor for THE TRI-LOK COMPANY)

DRAVO

IMPORTANT
assembly savings

RECONVERSION TIME is cost-cutting time. Many of the foremost machinery builders are finding that by simply *peeling* precision laminations from Laminum shims, much costly machining is made unnecessary in accurately fitting bearings, gears, etc. These savings are specific, and large enough to be important. Want performance data?

Laminum shims are cut to your specifications. For maintenance work, however, stock shim materials are sold through industrial supply houses.

Laminated Shim Company, Incorporated.

LAMINUM

THE SOLID SHIM THAT *peels* FOR ADJUSTMENT

2218

• Keep Informed

connections to the machine are grouped in a conveniently located manifold. This grouping provides for simplicity of installation and maintenance.

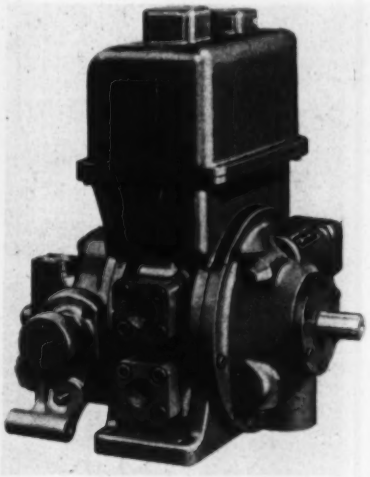
Among many other advantages, it is a complete and self-contained unit with all hydraulic components centralized and easily accessible for operating adjustment. In addition to the economy in installation, initial savings to machinery builders are represented by the use of Vickers standardized hydraulic control equipment.

Typical construction features and installation are shown in Bulletin 47-45.

Learning by Doing

One of 50 production employees now doing on-the-job training in the Beaver, Pennsylvania plant of Westinghouse Electric Corp. This young lady operates a machine that solidifies stranded copper wire shunts for Quicklag breakers then cuts each one to length. When in full production the plant, housing the Standard Control Division, will employ approximately 2000 men and women.

Oilgear New Fluid Power Variable Delivery Feed Pump

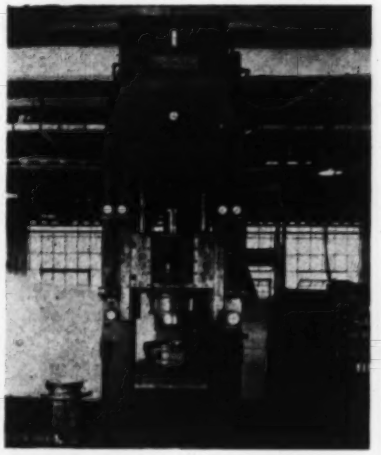


The Oilgear Co., 1307 W. Bruce Street, Milwaukee 4, Wis., has published a new 8-page bulletin 44200 illustrating and describing their New Fluid Power Variable Delivery Feed Pump that's simple, compact, electro-hydraulically controlled; easy to apply nearby or remotely and quick and positive in action; a development of importance to all machine tool builders, processing equip-

• Keep Informed

ment manufacturers and users. It's automatic pressure compensated. Fine and coarse feeds are adjustable over a 20:1 range. It provides from 13:1 to 265:1 variable ratios between feeding and rapid traverse speeds. Only two pipe lines are required. It's safe, easy to service. It's 25% lower in unit cost.

A New High Speed Deep Drawing Press



The hydraulic double-action deep drawing press shown in the illustration is of the self-contained oil hydraulic type and operates at very high speed. The press frame is a box-type all-steel, one-piece weldment of rigid construction in which the cast steel main and blankholder cylinders are inserted.

As shown in the picture, the complete oil hydraulic drive with pumps and motors is mounted on the press proper. Push buttons are provided which actuate the valves by means of solenoids. Control of the press is manual, semi-automatic or full-automatic.

The main slide has a capacity of 100 tons while the capacity of the blankholder slide amounts to 50 tons. Both slides may be coupled together to obtain a total capacity of 150 tons for single action work. Depending on motor size, drawing speed can be obtained up to 225"/min., at pressures up to 100 tons on the main slide, and fast advance and return speeds up to 1200"/min.

Vessels within a wide range of depth and shape can be drawn on this machine. Its speed, adaptability and space saving design makes it especially useful in the manufacture of household utensils from Light Metals and Stainless Steel.

The press was designed and built by Hydropress, Inc., 570 Lexington Avenue, New York, N. Y.

Industrial Scientists Predict Life Spans of Anti-friction Bearings

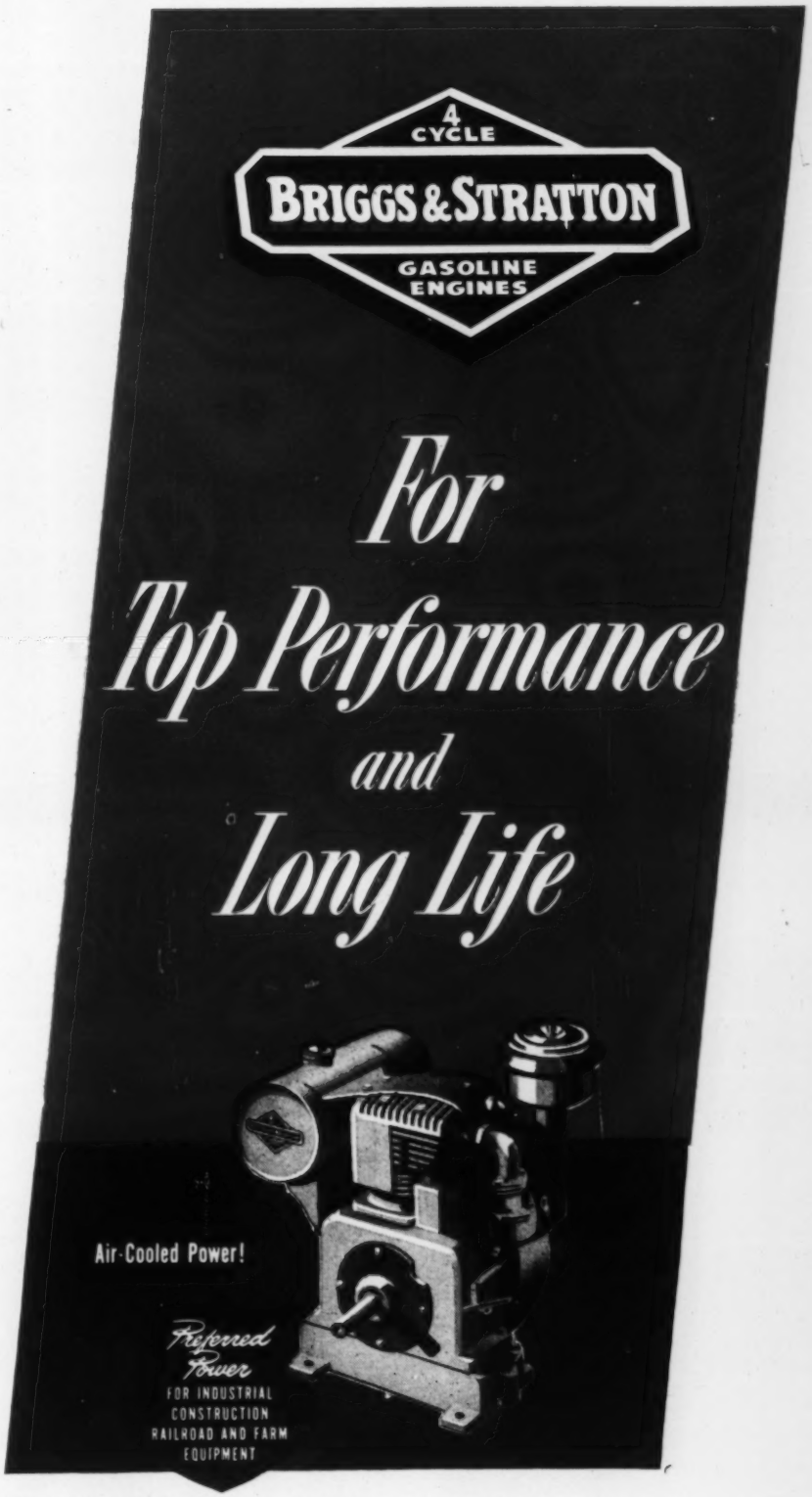
What does a precision industry have in common with an insurance company? Premiums? Risks?

The answer comes today not from a statistical survey but from a ball and roller bearing firm. Here at SKF Industries, Inc., life spans—not of people but of bearings—are being accurately predicted.

Dr. Haakon Styri, director of SKF research who might be regarded as an "industrial actuary," is delving into this phase of one of industrial science's most baffling problems. Concentrating on anti-friction bearings, he keeps detailed records of their life cycles as they are tested on a battery of 27 machines.

Under simulated service conditions, some of the test bearings have been run continuously, night and day, for as long as five years and more.

Continued on page 50



The Briggs & Stratton trademark on each gasoline engine is assurance of *reliable power* for your equipment. This is proven by the 28-year performance record of more than 3¼ MILLION Briggs & Stratton engines. Only engines sound in design and ruggedly built could create the world-wide preference which Briggs & Stratton engines *have earned.*

Briggs & Stratton engines *have more experience built into them* than any other 4-cycle air-cooled engines.

BRIGGS & STRATTON CORP., MILWAUKEE 1, WIS., U.S.A.

ThredKut *
INCREASED OUTPUT
4 to 1

... reports
JOHN L. MOROSINI
D. A. Stuart Oil Co.
Representative

"Prior to using THREDKUT,* this customer had tried several types of cutting oil in tapping 1½" dia. x 1" holes in very tough cast steel, with a maximum production of 50 tapped holes before sharpening was necessary. On switching to THREDKUT,* output immediately increased to 200 tapped holes between sharpenings. Here is another instance where THREDKUT* demonstrated its well-established reputation for licking a tough job."

John L. Morosini

ThredKut *

... Stuart's THREDKUT is a unique cutting oil carefully manufactured to insure the maximum benefits from controlled chemical activity. Its outstanding performance on really tough jobs has long been recognized and its flexibility proved through exceedingly widespread use. The many time-tested values built into THREDKUT are serving the leaders of the metal-working industry, increasing efficiency and reducing costs.

Ask to have a Stuart Service Engineer discuss your cutting fluid requirements. THREDKUT literature available on request.

STUART *service goes with every barrel*

WRITE FOR DETAILS

D. A. Stuart Oil Co.

2741 SOUTH TROY STREET, CHICAGO 23, ILL.

WORKS WHERE OTHERS WON'T

accurately formed

GRAPHALLOY OILLESS BEARINGS

SPECIFY GRAPHALLOY WITH CONFIDENCE

SELF-LUBRICATING ●
EXTREMELY DURABLE ●
CONSTANT CO-EFFICIENT OF FRICTION ● OPERATES DRY — OR SUBMERGED IN WATER, GASOLINE OR CORROSIVE LIQUIDS ● APPLICABLE OVER A WIDE TEMPERATURE RANGE — even where oil solidifies or carbonizes ● EXCELLENT AS A CURRENT-CARRYING BEARING.

GRAPHITE METALLIZING CORPORATION

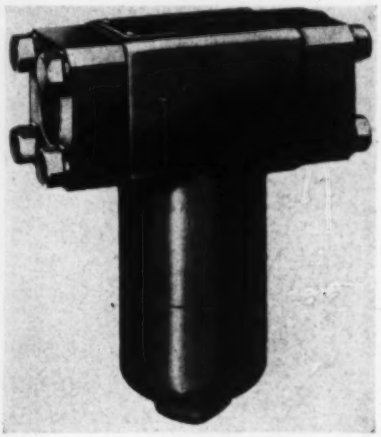
1058 NEPPERHAN AVENUE, YONKERS 3, NEW YORK

• Keep Informed

The results of this painstaking study over more than 25 years to date now make it possible to predict the life that 90 per cent of the bearings in a given group will exceed.

Vickers Proportional Type Oil Filter

The announcement of a new proportional type oil filter using a venturi design, by Vickers, Inc., 1500 Oakman Boulevard, Detroit, Mich., will be of considerable interest in the field of hydraulics.



The new design features a cartridge which filters out particles down to two microns in size (a micron is .000039 of an inch). Reversible filtering action with equal efficiency in either direction, meets the requirements of closed circuits. The use of a by-pass valve is not necessary as the venturi action in the new Vickers filter controls maximum pressure built up across the cartridge. Also, the filter is universally adaptable, being easily installed in any horizontal hydraulic system pressure line.

The protection afforded by the new Vickers filter, against dirt, sludge, chips, etc., reduces hydraulic equipment maintenance to a minimum. The result, improved system operating efficiency at lower cost.

There are no moving parts to wear out in the Vickers Proportional Type Oil Filter. Maintenance requirements are limited to a periodic replacement of the disposable and inexpensive cartridge.

For more detailed information, write for Bulletin 47-50.

Centrifugal Process Pumps

A new line of centrifugal process pumps designed for severe wear and particularly adaptable to the chemical, food and paper industries, has been announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Specially designed for handling corrosive and abrasive liquors where severe wear is encountered, the pumps are of extremely simple but rugged construction. They are equipped with larger shaft, heavier bearings and are of greater metal thickness. The bearing pedestal for supporting both pump parts and rotating assembly is cast in one piece to assure greater rigidity.

Pump parts subjected to severe wear are all separate pieces and can be easily replaced. Adjustable wearing clearance insures maintenance of capacity and efficiency without dismantling the pump and permits its operation for long periods of time without repairs.

The new pumps are available in five sizes with capacities up to 1,300 gpm at heads to 275 feet. The new line is described in a four-page bulletin just released. Copies of this bulletin—08B6615—can be obtained on request from Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

• Keep Informed

Amsco Nickel-Manganese Steel Plates Now Available for Conservation Welding

Simple, cost-saving repair or build-up of arge wearing areas is made possible with austenitic nickel-manganese steel plates now offered by the American Manganese Steel Div. of American Brake Shoe Co., Chicago Heights, Ill.

Torch-cut to desired size or shape and welded on with Amsco Nickel-Manganese Steel Rods or Electrodes, these impact and abrasion resisting plates provide: (1) Restoration of worn manganese steel or ferrous areas and (2) Pre-installation protection of ordinary ferrous parts at points subject to wear. An almost unlimited list of applications includes: wearing areas of chutes; jaw crusher cheeks and liners; dipper fronts, sides, and doors; dragline bucket bottoms; and surge bins.

Amsco Austenitic Nickel-Manganese Steel Plates—latest addition to the Amsco Conservation Welding line—are available 1/4", 3/8", 1/2", 5/8", 3/4", or 1" thick either in the standard 4' × 12' size or cut to order.

• BUSINESS CHANGES

Syntron Buys New Plant

Syntron Co., Homer City, Pa., manufacturers of vibratory material handling equipment and portable construction and maintenance tools has purchased the former H. K. Porter Co. shell plant at Blairsville, Pa., twelve miles from Homer City.

This mill type building with cranes, monorails, indoor railroad loading platforms, etc., will add 100,000 square feet of modern, up-to-date, heavy manufacturing facilities to their main plant at Homer City.

Syntron plans to transfer the manufacture of its large, heavy duty vibratory feeders and conveying equipment to Blairsville, which will release space at Homer City, to take care of new products and increased production of its present lines of Electric Tools, Gasoline Hammers, Concrete Vibrators, Paper Joggers, Shaft Seals and other products.

The Company's general offices and headquarters will remain at the Homer City, Pennsylvania plant.

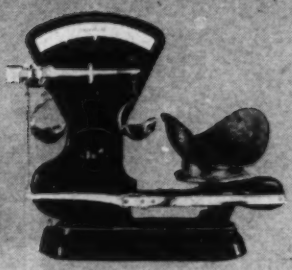
Springfield Boiler Co. Announces Appointment of Representatives

Springfield Boiler Co., Springfield, Ill., announces the appointment of the firm of Edward F. Masterson & Son, 18 New Derby St., Salem, Mass., as representative for the company in the New England territory, including the states of Maine, New Hampshire, Vermont, Rhode Island, and Massachusetts. The principals of the firm, Edward F. Masterson and William Masterson, are well-known consulting engineers in this area and represent a number of allied manufacturers.

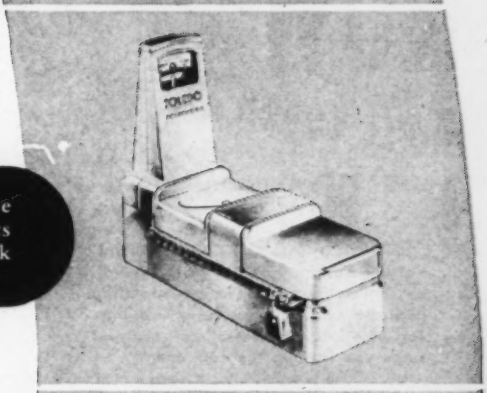
In Chicago, George Power has recently been appointed representative of the company with headquarters located at 612 N. Michigan Ave. Other recent Springfield appointments include Carswell Marine Associates at 417 Market St., San Francisco, Calif., covering the Pacific Coast and Alaska.

Continued on page 52

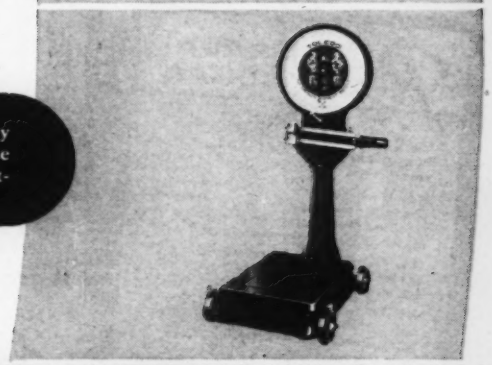
Control Costs



COUNTING SCALES—These Toledos count large quantities of small parts fast . . . ACCURATE. Eliminate slow and inaccurate hand-counting.



OVER-UNDER SCALES—The Speedweigh saves time and cuts costs in packing, filling, check weighing.



PORTABLE SCALES—Highly versatile . . . these Toledos are world's most widely used portable dial scales.

Whether it's weighing, counting, force-measuring, batching, testing or any problem in weight-control . . . it's a job for accurate Toledo Scales! They'll help you control costs, improve product-quality and increase production. Send for bulletin No. 2020. Toledo Scale Co., Toledo 12, O.

TOLEDO

HEADQUARTERS FOR SCALES

NOW

WHO'LL LUBRICATE IT?

The LUBRIPLATE Tag Service assures the machinery manufacturer, who uses LUBRIPLATE for initial lubrication, that the machines will be serviced with the same outstanding lubricant. Machine Builders, use the Tag Plan. Machine users, mail the post cards you find on the equipment.

℞ FOR YOUR MACHINERY

No. 2 — Ideal for general oil type lubrication, ring oiled bearings, wick feeds, sight feeds and bottle oilers.

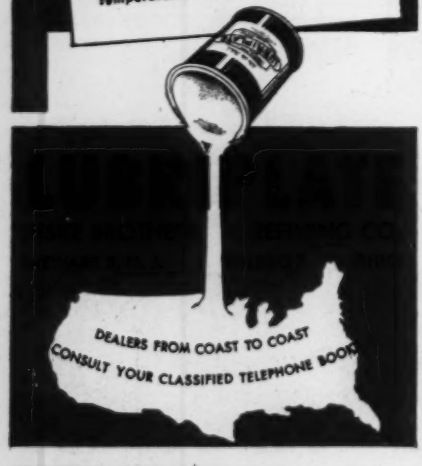
No. 8 — Because of high film strength and long life it reflects outstanding performance in most types of enclosed gears (speed reducers).

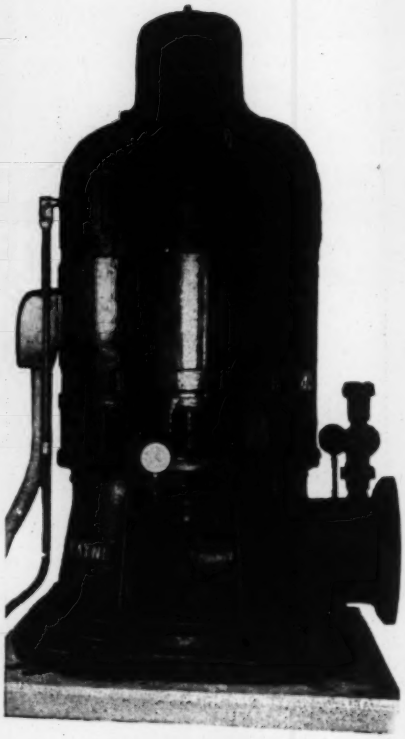
No. 107 — One of the most popular grease type products for general application by pressure gun or cups.

No. 70 — For a wide range of grease applications, especially at temperatures above 200 degrees F.

No. 130-AA — Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

BALL BEARING — This is the LUBRIPLATE Lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.





6 MILLION GALLONS DAILY

FOR JANESVILLE, WIS.

Janesville is a mighty lucky city. Their newly installed Layne Water Supply Unit is producing over 6,000,000 gallons daily with enough water on reserve for 16,000,000 gallons daily from the same well. The drawdown beyond the six-million gallons daily is almost negligible. Such a record is greatly attributed to the soundness of Layne's fine engineering and splendid installation methods.

Every Layne Well Water Supply Unit is designed and built to produce the absolute maximum amount of water at a minimum of cost. Many installations exceed the Layne guarantee, thus richly rewarding the buyer for his confidence in the Layne Organization and their proven methods.

If your city, factory, processing plant, railroad or irrigation project needs more water Layne Engineers will gladly provide dependable water development recommendations. No obligation. For literature, address Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

LAYNE

WELL WATER SYSTEMS

vertical turbine pumps

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. * Layne-Atlantic Co., Norfolk, Va. * Layne-Central Co., Memphis, Tenn. * Layne-Northern Co., Mishawaka, Ind. * Layne-Louisiana Co., Lake Charles, La. * Louisiana Well Co., Monroe, La. * Layne-New York Co., New York City * Layne-Northwest Co., Milwaukee, Wis. * Layne-Ohio Co., Columbus, Ohio * Layne-Pacific, Inc., Seattle, Wash. * Layne-Texas Co., Houston, Texas * Layne-Western Co., Kansas City, Mo. * Layne-Western Co. of Minn., Minneapolis, Minn. * International Water Supply Ltd., London, Ont., Can. * Layne-Hispano Americana, S. A., Mexico, D. F.

• Keep Informed

In addition to the above, the company now has representatives located in New York, Philadelphia, Washington, D. C., Reading, Pa., Detroit, St. Louis, Cincinnati, St. Paul, Houston, Mexico, D. F., and Buenos Aires, Argentina. The export business of the company is handled largely by the Mercator Corp. of Reading, Pa.

Fairbanks-Morse Changes

Fairbanks, Morse & Co., Chicago, announce the following changes in their sales organization.

J. C. Elmburg, Manager of the Company's Boston Branch House, has been transferred to the Company's Atlanta, Georgia, Branch House to assume the position of Manager of that area. He replaces Mr. G. N. Van Epps who recently resigned.

V. O. Harkness, who has been Manager of the Diesel Division at Chicago Headquarters, has been appointed Manager of the Boston Branch and T. M. Robie of Chicago has been appointed to the position of Manager of the General Diesel Sales Division.

Babcock & Wilcox to Complete Drum Shop Expansion this Month

An addition to the Number 3 Drum Shop of The Babcock & Wilcox Co. will be completed soon, according to a recent announcement by company officials. This is part of the previously announced expansion program. The addition, 275 × 100 feet, will bring the total length of the shop to about 600 feet, resulting in a substantially expanded area for the fabrication of drums.

A 100 ton crane will be installed, along with additional welding equipment and drum turners. The new equipment will facilitate handling of the largest drums and vessels fabricated by Babcock & Wilcox, such as boiler drums for large central stations, pressure vessels and alloy lined vessels for the oil, paper and chemical industries.

Officials said that this addition will help the company meet the unprecedented demand by public utilities for steam generating equipment.

• LATEST CATALOGS

Oil and Gas Burners

Peabody Engineering Corp. Condensed 4-Page Bulletins #803 and #903 respectively describe the operation of heavy-duty mechanical and steam-atomizing oil burners and combined gas and oil burners for industrial boilers, heaters and furnaces as well as central station installation. Compact, dependable, fully-automatic fuel oil pump and heater sets also furnished.

SKF Issues New Bearing Catalog

How anti-friction bearings increase the rigidity and accuracy of machine tool spindles, many of which are being equipped with the spectacular carbide tools that permit greater speeds, feeds and depth of cut is explained by SKF Industries, Inc., in a new comprehensive 60-page catalog of machine tool bearings and spindle designs.

Bearing applications for turning and boring equipment and grinding machines are discussed in detail and include those for single and multiple spindle lathes, boring heads, milling machines, drill spindles and bore, O. D., surface, tool and special purpose grinders.

A section devoted to engineering principles relates cutting tool loads to bearing life and also deals with bearing selection, load distribution, speed limitations, mounting and distribution. Other sections touch upon bearing tables and load data, for cylindrical roller, thrust ball and angular contact bear-

• Keep Informed

ings, tolerance tables and shaft and housing dimensions.

A description of the oil mist lubricator developed by SKF and designed to lengthen the life of spindle bearings from seven hundred to as much as several thousand hours is contained in the catalog which is illustrated with numerous charts and diagrams.

Self-Contained Temperature Regulator

Leslie Co., 72 Delafield Ave., Lyndhurst, N. J. manufacturers of Pressure and Temperature Regulators and Controllers, Strainers and Whistles has just released a new illustrated folder entitled "Controlled Heat" describing its new line of Class "T" Self-Contained, Self- Acting, Temperature Regulators.

New folder tells how accurate temperature control can be obtained at reasonable cost for many industrial applications including heating water for wash rooms, laundries, chemical and food process equipment, etc.

Important features of this new regulator as described in this folder include single-seated construction in all sizes for steam pressures up to 125 psi.; packless main valve; hard faced seating surface and hardened wearing parts; liquid filled thermostatic element—all of which are stated to assure positive control response to small temperature changes, as well as assure positive dead-end shut-off, long life and simple maintenance.

Sizes available are from $\frac{1}{2}$"–4" inclusive for steam pressures to 125 psi (175 psi liquid) and temperatures to 450 deg. F.

Data on selection, installation, operation and maintenance are included.

Load and Pressure Cells

The Baldwin Locomotive Works, Testing Equipment Dept., Philadelphia 42, Pa., announces three new bulletins that describe and illustrate its three types of load cells:

Bulletin 264, 4 pages. Covers the New Tate-Emery Air Cell, an independent tension and compression load-weighing device which extends the precision range of testing machines to low values of load.

Bulletin 271, 2 pages. Covers five sizes of the New Sr-4 Load Cells in which the SR-4 bonded resistance wire strain gage translates changes in tensile or compression loads into changes in electrical energy.

Bulletin 270, 2 pages. Covers five sizes of the New SR-4 Fluid Pressure Cell that converts pneumatic or hydraulic pressures in pressure vessels, pipe lines, etc., into changes of electrical energy by means of an SR-4 bonded resistance wire strain gage element.

Hannifin Offers New Bulletin On Hydraulic Cylinders

Publication of the new 52-page illustrated bulletin on double-acting hydraulic cylinders is announced by Hannifin Corp., 1101 South Kilbourn Avenue, Chicago, and copies are offered without charge to individuals engaged in work involving the use of this type of equipment. Planned primarily to provide a complete source of information and data for design engineers, the manual also contains material of value to engineers in charge of installation, operation, and maintenance of hydraulic power equipment.

One of the interesting features of the bulletin is the presentation of eleven standardized mounting styles which can be used in a variety of combinations to solve almost any conceivable power application problem without involving special designing and construction. The use of differential hydraulic circuits as a means of providing for a fast return stroke in cylinder operation is also discussed and illustrated along with explanation of the functioning of hydraulic cushions. In the ref-

Continued on page 54

Into the Night...

Men of science are constantly probing . . . ever seeking . . . always wondering . . . never satisfied.

Every fresh discovery reveals anew the vastness of that "Great Undiscovered Ocean of Truth," and presents countless new problems in MEASUREMENT.

To keep abreast with the ever-changing needs of modern research, Hathaway engineers are constantly working on new measuring instruments, constantly improving older ones. Whatever may be YOUR new problem in MEASUREMENT OR CONTROL, Hathaway experience can help you.

Hathaway Type S8-B 12-Element Recording Oscillograph

- For general-purpose laboratory and field use
- Advanced in design, exacting in craftsmanship
- Complete with every device for accuracy and convenience

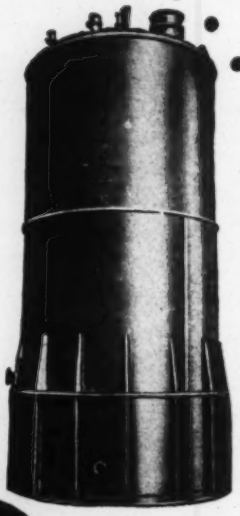
ONE OF A COMPLETE LINE OF RECORDING OSCILLOGRAPHS, GALVANOMETERS, AND HIGH-SPEED RECORDERS

Write for Technical Bulletin SP-165 D

Hathaway INSTRUMENT COMPANY

1315 SO. CLARKSON STREET • DENVER 10, COLORADO

NO MATTER HOW *Big* THE JOB— NO FLAW IS TOO *Small*



12′ diameter x 20′ high chemical processing vessel of 3/8″ aluminum. All welded construction.

Steel fractioning tower for synthetic rubber industry. 5′ 6″ diameter, 120′ high.

Deaerator tank with flanged and dished head, frustrated cone end — 10′ diameter, 26′ long.

NOOTER INSPECTION — CORRECTION TECHNIQUES ASSURE DEPENDABILITY

The larger the job, the greater the possible consequences of failure from some small flaw. For this reason, rigid inspection is the uncompromising Nooter formula for unvarying quality in each step of fabrication.

Hydrostatic or pneumatic tests on complete units and their fabricated parts, inspection of vital welds with X-ray equipment and stress relieving are important parts of Nooter procedure which never compromises with safety or quality.

Send for the Nooter Corrosion Data Charts Yours for the Asking

NOOTER ST. LOUIS

JOHN NOOTER Boiler Works Co. • 1432 S. Second St., St. Louis 4, Mo.

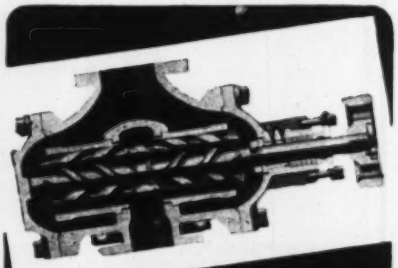
• Keep Informed

erence data section of the bulletin, formulae and data are provided for solving hydraulic cylinder problems involving piston diameters, pressure, pump delivery, piston velocity, and input horsepower requirements, together with a discussion of pressure drops in piping, pipe sizes, and fluid velocity in pipes. As an overall guide to proper selection of hydraulic cylinders, a check list is also included covering the points that should be considered in specifying cylinders and designing installations.

Multiport Water Relief Valve for Condenser Protection

In a Michigan plant a spray pond is employed to cool the condensing water but since an excessive supply of well water is available, the use of which would permit higher vacuums in summertime, it was proposed to circulate the colder well water through the condenser and the spray pond and a second time through the condenser and then allow it to spill to waste. Condenser tube sheets were designed for 85′ head while normal standpipe head was 104′, increased to 289′ during fire emergencies, making it necessary to provide pressure relief for protecting the condenser.

The problem was solved by installing an 8″ multiport water relief valve, with springs set to relieve at 15 psi. Thus, with a 29″ vacuum inside the steam space and 15 psi positive pressure in the water boxes, total pressure difference amounted to a maximum of 30 psi or 69′ of head across the tube sheet. The valve was designed to pass normal flow of 1500 gpm at a pressure rise of 3.8 psi above the initial 15 psi setting (77½′ differential) and an emergency flow of 2840 gpm at a pressure rise of 7.4 psi (85′ differential). An orifice was installed in the water inlet line to the



THE IMO PUMP IS RELIABLE BECAUSE IT IS SIMPLE....

The IMO pump has only three moving parts and no valves, timing gears, pistons, cams, vanes or delicate adjustments to get out of order or require maintenance.

IMO pumps have an outstanding record of trouble-free performance in lubrication, hydraulic, governor and fuel oil services.

For further information send for catalog 1-135-A.

IMO I MOVE OIL

IMO PUMP DIVISION of the DE LAVAL STEAM TURBINE CO. TRENTON 2, NEW JERSEY

• Keep Informed

condenser to produce sufficient pressure loss to protect the condenser inlet side during periods of emergency, creating only 56′ of head loss under normal conditions but a maximum of 220′ head loss under conditions of emergency head and flow, thus fully insuring protection of the condenser water boxes against bursting.

Cochrane Multiport Relief Valves are fully described in Publ. 4150 which may be obtained from Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia 32, Pa. In Canada write Canadian Allis-Chalmers, Ltd., 212 King Street West, Toronto, Ontario, Canada.

Mechani-Seal Transmission Units

Information about light series pillow blocks, flange cartridges and cylindrical cartridges equipped with sealed wide inner ring ball bearings is contained in a new 8-page folder. The units described are widely used for carrying light or normal loads in applications where simplicity of installation is an important factor. Photographs, sectional drawings, specifications and load ratings are included. Ask for LAK Folder. The Fafnir Bearing Company, New Britain, Conn.

Pedestal Type Centrifugal Pumps

A new bulletin telling of the operating advantages and construction features of its new line of "Pedrifugal" pedestal type centrifugal pumps has been released by the Allis-Chalmers Mfg. Co.

According to the bulletin, five sizes of this versatile pump handle all general pumping requirements up to 500 gallons per minute and up to 100 ft. head. Also possible, is an unlimited range of intermediate capacities and heads.

In addition to diagraming nine construction features which make for low cost and efficient operation, the bulletin carries pump, motor and Texrope drive selection table to permit correct selection of pump size, motor operating speed and Texrope drive to give the capacity desired. Also included are standard dimension tables of the "Pedrifugal" pump, which is stocked and sold with or without motors.

The "Pedrifugal" can be powered by electric motor or gasoline engine. If desired, pump, steel base, Allis-Chalmers motor and Texrope V-Belt equipment can be supplied as a unit.

Copies of the new bulletin—52B6691—are available upon request from Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

New De Laval Worm Gearing Bulletin

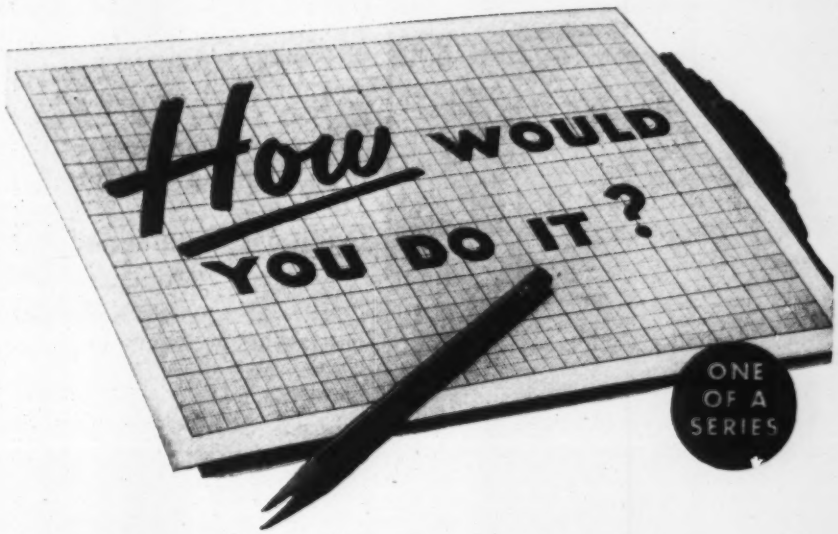
Bulletin WG1220-5-46, just issued by De Laval Steam Turbine Co., Trenton 2, N. J., describes and illustrates advantages of worm gearing, AGMA service classification, bearing load formulae, quality control and precision manufacturing, selection practice, horsepower ratings, worm thread and gear tooth data for different ratios, dimensions and details of standard worm mountings, worm dimensions, gear dimensions and dimensions of standard flanged rims.

"Production Road"

The latest edition of "Production Road," Twin Disc Clutch Co. magazine, is a comprehensive yet compact pictorial exposition of the multitude of uses modern American industry makes of powered machinery.

Called a "Blue Book of American Industry," by P. H. Batten, President of the Twin Disc Clutch Co., the "Manufacturers' Issue" is divided into the following major classifications: construction and material handling, logging and lumbering, oil production, farm-

Continued on page 56



PROBLEM—You're designing a taxi-cab meter. You have worked out the mechanism that clocks waiting time and mileage and totals the charges. Your problem now is to provide a drive for the meter from some operating part of the cab—bearing in mind that the meter must be located where the driver can read it and work the flag. How would you do it?

THE SIMPLE ANSWER

Use an S.S.White power drive flexible shaft. Connect one end to a take-off on the transmission and the other to the meter. It's as simple as that—a single mechanical element that is easy to install and will operate dependably regardless of vibration and tough usage. That's the way a leading taximeter manufacturer does it as shown below.

★ ★ ★

This is just one of hundreds of power drive and remote control problems to which S.S.White flexible shafts are the simple answer. That's why every engineer should be familiar with the range and scope of these "Metal Muscles"* for mechanical bodies.

WRITE FOR THIS 260-PAGE FLEXIBLE SHAFT HANDBOOK—It gives complete facts and technical data about flexible shafts and their application. A copy is yours free if you will request it on your business letterhead and state your position.

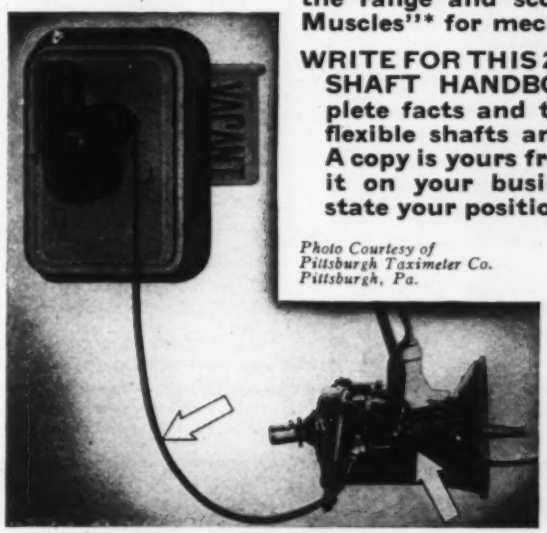


Photo Courtesy of Pittsburgh Taximeter Co. Pittsburgh, Pa.

*TRADE MARK Reg. U.S. Pat. Off. and Elsewhere

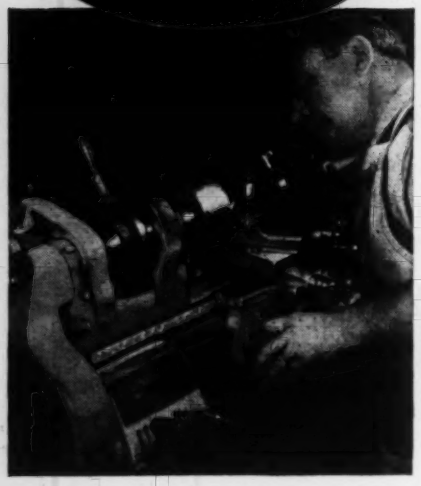
S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO. DEPT. L, 10 EAST 40th ST., NEW YORK 16, N. Y.

FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RESISTORS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

One of America's AAAA Industrial Enterprises

QUALITY-BUILT
FOR QUALITY WORK



The quality built into South Bend Precision Lathes enables them to produce quality work with efficiency regardless of the type of machining. Close tolerances can be maintained and a maximum volume of fine work produced with a minimum of effort.

ORDER NOW FOR EARLY DELIVERY

Factory Time Payment Plan Available

BENCH LATHE PRICES

9" x 3' Model C, 6 speed . . . $145.00
9" x 3' Model B, 6 speed 195.00
9" x 3' Model A, 12 speed . . . 270.00
10" R. x 3' Quick Change Lathe 788.00

FLOOR LATHE PRICES

13" x 5' Quick Change Lathe $1090.00
13" x 5' Toolroom Lathe 1418.00
14½" x 5' Quick Change Lathe 1309.00
14½" x 5' Toolroom Lathe . . . 1662.00
16" x 6' Quick Change Lathe . 1567.00
16" x 6' Toolroom Lathe 1958.00

All prices f. o. b. factory, less electrical equipment. 9" Bench Lathe prices quoted less bench. Price increases on South Bend Lathes average less than 15 per cent over the prewar levels.

WRITE FOR CATALOG 100-F

Describes South Bend Quick Change and Toolroom Lathes with 9" to 16" swings; Precision Turret Lathes with ½" and 1" collet capacities. Also attachments and tools.

Building Better Lathes Since 1906

SOUTH BEND LATHE WORKS
517 EAST MADISON STREET
SOUTH BEND 22, IND.

SOUTH BEND LATHES

Polaroid*... *Photoelastic Polariscope*

for Stress Determination

For either qualitative or quantitative photo-elastic analysis, perfection in the projection lens system is of major importance.

In our new model polariscope of 4¼" clear aperture, the parallel beam is collected by a rear element and condensed through a three component lens of the Cooke system. In the new larger unit (8¼" aperture) a four component lens of the Omnar system is used. *The image is sharp throughout the field, free of aberration, astigmatism, and distortion.*

Literature of new model polariscope now available

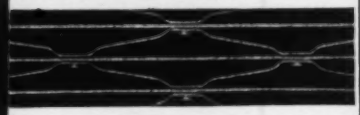
POLARIZING INSTRUMENT CO., Inc.
41 East 42nd Street, New York 17, N. Y.

**T.M. Reg. U. S. Pat. Off. Polaroid Corporation*

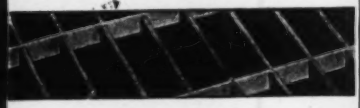
IRVING GRATING

FLOORING AND STAIR TREADS

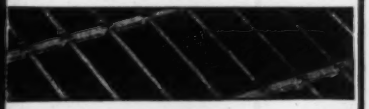
"A Fitting Grating for Every Purpose"



Riveted
Walkways — Stair Steps — Platforms
Trucking Aisles — Trench Covers



Press-Locked
Industrial Plants — Oil Refineries
Chemical Plants — Power Houses
Naval and Merchant Ships
Locomotive, Passenger and Freight Cars



Welded
Catalog for the asking.

IRVING SUBWAY GRATING CO., INC.
ESTABLISHED 1902
HOME OFFICE and PLANT 5010 27th STREET
LONG ISLAND CITY 1, NEW YORK
WESTERN DIVISION FOOT OF PARK AVE.
EMERYVILLE 8, CALIFORNIA

• Keep Informed

ing, railroading, metal fabrication, fishing and boating, and engine building.

The new publication contains 52 pages and 153 illustrations showing machines and engines which incorporate the use of Twin Disc units. A total of 360 manufacturers are listed who install as standard or optional equipment Twin Disc Clutches, Power Take-offs, Reduction Gears, Machine Tool Clutches, Marine Gears and Multiple Engine Hydraulic Drives, Hydraulic Couplings and Power Take-offs, Hydraulic Torque Converters, and Air-actuated Clutches.

It is expected that the builders, users and students of powered industrial machinery will find the "Manufacturers' Issue" of "Production Road" to be a useful reference work because of the valuable data and wide variety of photographs reproduced in the magazine. Copies may be obtained without charge by writing the Twin Disc Clutch Co., Racine, Wisc.

Steam Generating and Fuel Burning Equipment

Combustion Engineering Co., Inc., 200 Madison Ave., New York 18, N. Y., has available a condensed, general catalog of Combustion Engineering products which comprise all types of steam generating, fuel burning and related equipment. Various types of boilers, stokers, pulverizers and burners as well as superheaters, economizers and air heaters are treated briefly. Complete units covered span the whole range of capacities from 1,000 to 1,000,000 lb of steam per hr.

Hot Process Water Conditioning

The essential function of a hot process water conditioning system is explained and diagramed in a new 12-page bulletin released by Allis-Chalmers. Included is a description of the equipment and an explanation of what it is designed to do, together with the mechanism of its operation.

The bulletin tells of the system's reaction and sedimentation tank, raw water inlet regulating valve, spray heater, vent condenser, vacuum breaker, recording thermometer, and chemical feeding equipment. It also discusses condensate and treated water storage.

Basis for information contained in the bulletin is years of water conditioning supervisory and consulting duties by Allis-Chalmers engineers in low and high pressure plants throughout the United States.

Copies of the bulletin—28B6611—are available upon request from the Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Steam Generators by Springfield

A new 12-page bulletin published by Springfield Boiler Co., 1961 East Capitol Ave., Springfield, Illinois, illustrating and describing the Springfield line of 2-drum bent tube and sectional header cross drum boilers. Designs featured include Springfield Type M standardized boilers for small and medium size plants, with complete data and dimensions.

Foxboro Valve Bulletin

"Pneumatic Control Valves and Controller Accessories", the 36-page Bulletin 277-2 of The Foxboro Co., 182 Neponset St., Foxboro, Mass., has just been issued in a new edition, with revisions as needed, and all contents brought up to date. Copies will be mailed on request.

Features of the new bulletin include: a color page showing the various identifying enamel finishes offered on Stabilflo Valves, corresponding with the color code of the American Standards Association; plates and tables of specifications for control valves,

• Keep Informed

needle type valves, poppet valves and butterfly valves; separate sections on the Vernier Valvactor for high-accuracy positioning of valve plungers, and on air switches and sub-panels for remote valve control. Information is supplied on the computing of valve sizes, with tables and formulae for determining the size of the correct valve for a contemplated installation. Air filter sets, ventilating dampers, and other accessory equipment are illustrated and described.

Impact Test Machine

Bulletin 253, 4 pages, $8\frac{1}{2} \times 11$ in. Describes and illustrates two Sonntag Universal Impact Machines of the pendulum type with capacities of 48 ft. lb. and 240 ft. lb. for making Charpy, Izod, and tension tests on plastics and metals. The Baldwin Locomotive Works, Testing Equipment Dept., Philadelphia 42, Pa.

Ram-Feed Stokers

Eight-page bulletin of The Brownell Co., 446 N. Findlay St., Dayton 1, Ohio, illustrates and describes Types R and RI Ram-Feed Stokers. Capacities with single retorts are 150 to 560 boiler h.p. Twin retorts available for larger requirements. May be equipped with automatic air volume and coal feed controls. When operating intermittently, ram remains at innermost point of feed stroke to seal coal tube against blowback. Stokers have mechanical precision and rugged construction for long, economical service. Manufacturer's reputation for building dependable boiler-room equipment dates back to 1855.

Aftercoolers

The benefits, principle and application of aftercooling, and a complete description of a line of Type "PL" and "M" aftercoolers are fully covered in a new 16-page, 2-color bulletin recently published by Ingersoll-Rand.

Several pages illustrate the various I-R aftercoolers with cross-sectional views and description of their operation. One spread is devoted to a typical compressor plant set-up, showing a photograph of a complete layout, including compressors, intake filter, piping, aftercooler, receivers, headers and control panel. A selection table for choosing the proper size aftercooler for specific compressor output is also included in this bulletin.

This practical presentation should be of use to anyone operating or installing air or gas compressor units. Additional information may be obtained by writing Ingersoll-Rand, 11 Broadway, New York 4, N. Y., or any of its branch offices. Ask for Form 3014-B.

Water-Cooled Flexible Leads

Titeflex water-cooled, flexible leads for use in conducting high frequency currents are described in a folder just issued by Titeflex, Inc., 521 Frelinghuysen Ave., Newark 5, N. J. Included is a description of the tests which demonstrate the low power loss resulting from the use of the Titeflex lead.

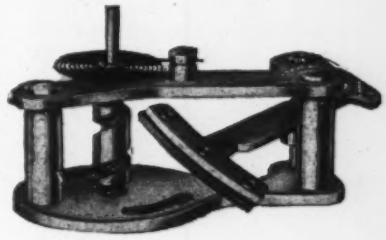
A New Era in Liquid and Gas Flow Measurement

A new 32-page bulletin is now available entitled "A New Era in Liquid and Gas Flow Measurement" profusely illustrated and full of informative material describing the numerous advantages of the "Flowrator" meter (Formerly called Rotameter) for flow rate measurement. Clearly discussed are important topics such as: Basic Principles . . . Flexibility (for changing operating conditions) . . . Extremely high accuracy . . . Linear flow characteristics . . . Wide flow range . . .

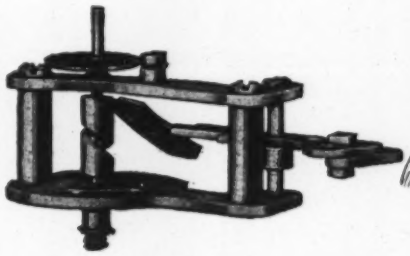
Continued on page 58

Do You Prefer A Right or Left Hander?

Helicoid Pressure Gages are made with either a right-hand movement or a left-hand movement—whichever is best for the service. Each movement offers an exclusive advantage not possible with any ordinary spur gear movement.



WITH THE RIGHT-HAND MOVEMENT, the cam releases from the roller just after the maximum dial pressure is reached. Thus, any over-pressure in the gage will do no harm whatever. Even the accuracy of the gage won't be affected provided the elastic limit of the Bourdon tube isn't exceeded.



WITH THE LEFT-HAND MOVEMENT, the cam releases from the roller just below the minimum dial graduation. Thus, any under-pressure, such as sudden vacuum, will do no harm whatever. The left-hand movement is ideal for hydraulic press gages or for sudden or violent pressure drops.

Only the Helicoid Movement has these advantages. And only Helicoid Gages have the Helicoid Movement.

ACCO

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut

• Keep Informed . . .

Immunity of calibration to variations in fluid viscosity, and many other subjects of real interest to the engineer unacquainted with variable-area type of flow measurement instruments.

Address your request for this literature to Fischer & Porter Co., Department 7A-F, Hatboro, Pa.

Strain Gage

Bulletin 265, 2 pages, $8^1/_2 \times 11$ in. Describes and illustrates the deForest Recording Scratch Gage, smallest and lightest self-contained recording strain gage ever devised. The Baldwin Locomotive Works, Testing Equipment Dept., Philadelphia 42, Pa.

New Type of Solids-Handling Pump

A new type of Solids-Handling pump with a special back cover allowing for two rings of packing between the seal cage and the area of the casing in back of the impeller has been announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

This unit with its new stuffing box arrangement is intended for applications where dilution must be kept to a minimum, even though it may result in reducing the life of the sleeve and packing. This type of pump does not have a stuffing box wear plate.

The new Solids-Handling pump is an addition to the line produced by the company for several years, which has its seal cage immediately adjacent to the area of the casing in back of the impeller. This latter unit has been used successfully in pumping such solids as slurries, tailings, pulps, sludges, etc., where materials must be kept out of the stuffing box, regardless of dilution, or where dilution is not considered a disadvantage.

Combining a special design plus a new, highly abrasive-resistant alloy, the Allis-Chalmers Solids-Handling pump is said to outlast ordinary pumps two to four times. It is available in capacities from 175 to 7,000 gpm at heads through 100 feet.

Weekly Wall Calendar—for 1948

The Frederick Post Co. Branches and Distributors are proud to offer the 1948 Popular Weekly Wall Calendar with big dates that command attention in Drafting Rooms, Offices or factory.

"Steam Shovel at Work" is the theme. Beautifully illustrated in four-color process with six-color tone effects—size 12″ × 20″ spiral bound, with engineering data and full twelve months on back.

This fine calendar says here is a quality piece from a quality house—handling quality merchandise.

Free copies of the 1948 Weekly Wall Calendar may be secured by writing The Frederick Post Co., P. O. Box 803, Chicago, or your nearest Post distributor.

Forged Boiler and Tank Accessories

A catalog on forged boiler and tank accessories recently has been published that gives complete buying information on manhole and handhole plates and yokes. This 20-page booklet contains illustrations, dimensional drawings, table of weights and sizes and descriptive information on manhole covers and yokes, handhole covers and yokes, welding street ells and water column ells. Comparable designations giving chemical propositions and tensile properties of the products as well as hydrostatic test data are presented. Information about curving handhole covers aids the users of this product. Write for Catalog 11 to The Steel Improvement & Forge Co., 952 East 64th Street, Cleveland 14, Ohio.

Flow Meters

A new 12 page $8^1/_2″ \times 11″$ illustrated Bulletin No. 35-83A on the ADSCO Flow Meter of the orifice type for indicating, recording and integrating the flow of steam, gas and air gives details of construction, data on orifice plates, etc., and may be obtained upon request from American District Steam Co., North Tonawanda, N. Y.

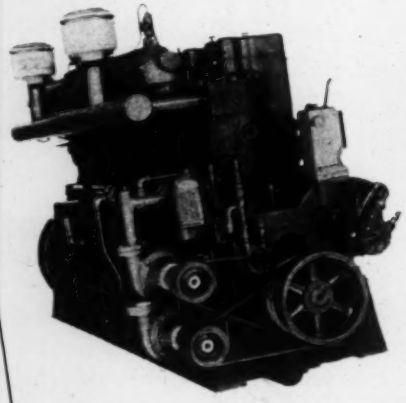
Creep Testing Machine

Bulletin 272, 2 pages, $8^1/_2 \times 11$ in. Describes and illustrates a New creep testing machine of 12,000 lb. capacity for testing conventional specimens at high temperatures. The Baldwin Locomotive Works, Testing Equipment Dept., Philadelphia 42, Pa.

Centrifugal Blowers and Exhausters

New 12-page Booklet A-650 describes many applications of Hoffman Blowers and Exhausters on production operations which require air pressure from one to eight pounds per square inch on vacuum from 2 to $11^1/_2$ inches of mercury.

Design features are explained graphically, and operating characteristics and advantages are described. The booklet includes charts showing capacity ranges, as well as a "Handy Data" page of tables, conversion factors and graphs to aid in determining blower or exhauster requirements. United States Hoffman Machinery Corp., Air Appliance Division, 105 Fourth Ave., New York 3, N. Y.



TUTHILL "Stripped" PUMPS For Your Machinery

Save space, reduce costs and improve appearance with Tuthill Stripped Pumps built directly into the design of your machinery. Ideal for lubrication, coolant, hydraulic and liquid transfer service. Two types available: Type S, without mounting bracket; and Type SA, pumping elements only. Capacities up to 200 g.p.m. Write for Tuthill Stripped Pump bulletin.

TUTHILL PUMPS

TUTHILL PUMP COMPANY

939 East 95th Street • Chicago 19, Illinois

ROCKFORD

LIGHT OVER-CENTER CLUTCHES

COMPACT DESIGN
POWERFUL PULL
SMOOTH ENGAGEMENT *
UNIFORM PRESSURE
FINE ADJUSTMENT
ACCURATE BALANCE
LONG SERVICE LIFE

* The smooth-operating toggle action slides the drive plate along the accurately machined collar, applying the pressure evenly — and directly opposite the facing. The clutch plates are steel and the facing is specially selected for its firm grip, long wear and non-grab qualities.

Send for This Handy Bulletin

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

BW BORG-WARNER

ROCKFORD CLUTCH DIVISION BORG-WARNER
1307 Eighteenth Avenue, Rockford, Illinois, U. S. A.

AIR ECONOMY

AND THERE'S A "Buffalo" FAN ENGINEERED FOR ANY AIR JOB YOUR BUSINESS CALLS FOR!

When you buy a fan, you naturally want it to deliver the required *volume* of air—at correct *pressure*—without wasting *power*. You want quiet, trouble-free service for a good many years. The wrong type and size of fan is a waste of money, while the *right* fan is the soundest kind of economy.

This is why "Buffalo" builds all types. There are "Buffalo" fans to handle 33,000 TONS OF AIR IN A DAY—and "Buffalo" fans to ventilate small rooms—draft fans for every type of furnace—exhausters to remove materials, air or corrosive fumes—disc fans, centrifugal fans, axial flows—all in such wide ranges of capacities that you can pick the most economical and efficient fan!

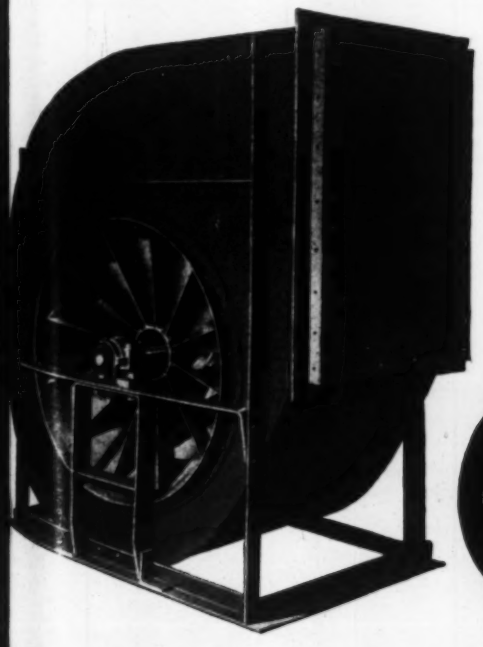
BEFORE YOU SELECT A FAN, you'll save money by looking into the "Buffalo" line. Why not write us for the "fan facts" concerning your air problem?

BUFFALO FORGE COMPANY

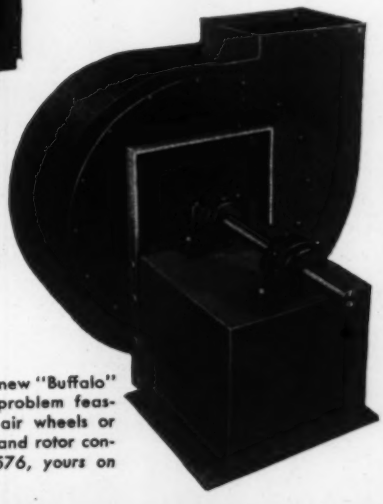
148 Mortimer St. Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

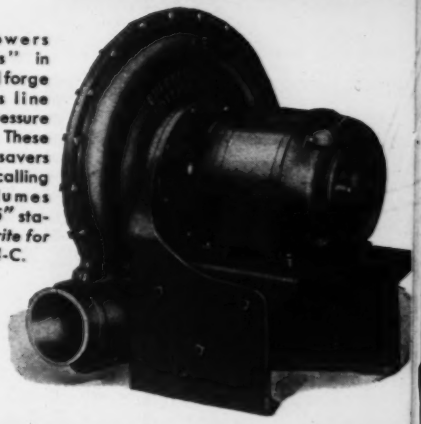
Demands "Special" Fans!



NEED LARGE VOLUMES OF AIR for ventilation? "Buffalo" Limit-Load Fans do it quietly and use little power. Ideal where installation is near curved duct connections. Note directional inlet vanes which minimize wasteful turbulence. In capacities from 600 to a half-million cfm. *Write for Bulletin 3339.*



"Buffalo" E Blowers are "specialists" in small furnace and forge blowing—gas line boosting — pressure cleaning jobs. These fans are money-savers in applications calling for small volumes against 0 to 3.65" static pressures. *Write for Bulletin No. 3014-C.*



INDUSTRY CALLS THIS THE "CLEAN" FAN! The new "Buffalo" Industrial Exhauster will handle any removal problem feasible with a pneumatic system. Furnished with air wheels or material wheels as desired. Rivetless housing and rotor construction give amazing efficiencies. *Bulletin 3576, yours on request, gives all engineering data.*

"Buffalo"

FANS FOR EVERY AIR JOB

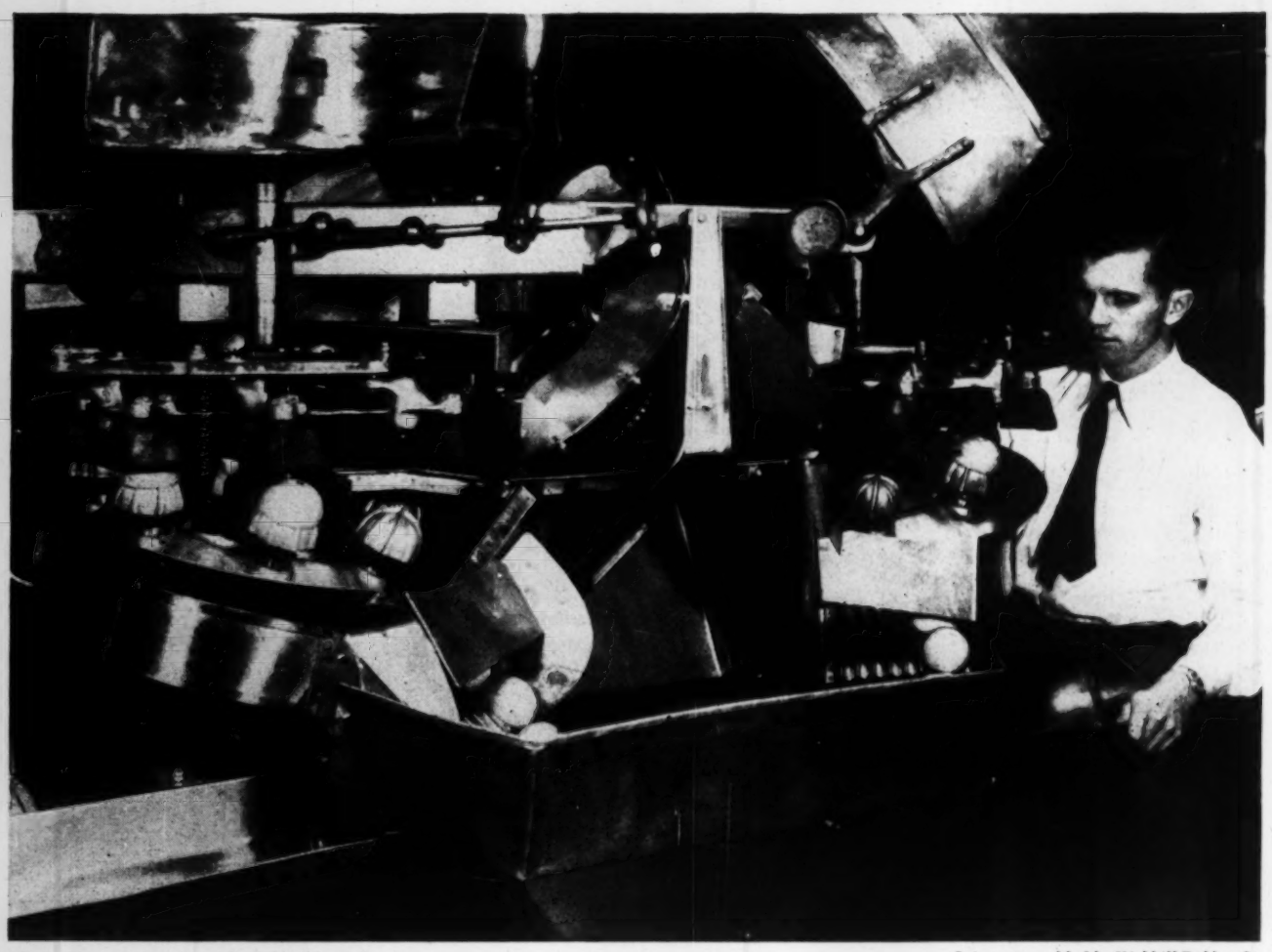


Photo courtesy Brown Citrus Fruit Machinery Co.

Juice cups molded by Kirkhill Rubber Co.

A Squeeze Play that benefits everyone

FLOODS of vitamin-rich juice are whirled from ripe oranges by this automatic Citrus Juice Extractor.

The squeeze is on the orange halves as they are gripped and firmly pressed against whirling metal cones by cups made from a compound of Geon polyvinyl resin and Hycar American rubber.

Because this composite material is unaffected by fruit oils, acids, moisture, because it is impervious to contamination, because the cups made from it perfectly perform their gripping function despite variation in the size of fruit, important benefits result.

Ripe fruit is fully utilized, waste prevented, a healthful food product is available on your grocer's shelves at modest price, the owners of the machine have substantially reduced the cost of maintenance and operation.

Geon polyvinyl resins and Hycar American rubber are materials for which new cost-saving, problem-solving uses are discovered almost daily. Molded, calendered, cast, or used as impregnants for fibres and fabrics, their versatility may contribute importantly to the product you make and to articles you use daily.

B. F. Goodrich Chemical Company makes no finished products from Geon or from any other raw material. However, we will be glad to work with you on any special problems of application. We are particularly interested in developing new end uses for these materials. For more information please write Department HF-12, *B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.*

Hycar
Reg. U. S. Pat. Off.
American Rubber

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • KRISTON thermosetting resins • GOOD-RITE chemicals

Eastman Kodak Company announces

THE BIG NEW PLUS

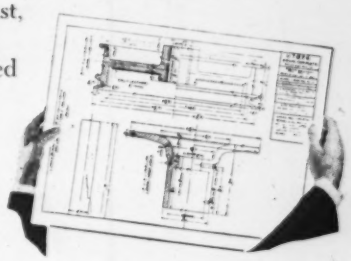
in engineering drawing reproduction . . .

Kodagraph Papers

With this—the announcement by Eastman Kodak Company, world's outstanding maker of photographic materials, of a new line of reproduction papers—you'd naturally expect a big new plus. And you're getting it: first—new Kodagraph Contact Paper which brings new features, new effectiveness to existing photographic reproduction methods. Second—revolutionary new Kodagraph Autopositive Paper that brings the unique advantages of photographic reproduction to direct process and blueprinting equipment.

The PLUS that Kodagraph Contact Paper brings to photocopying

Photographically, you can do things that can't be done any other way. You can get better printability from old and new drawings . . . reproduce blueprints, opaque drawings. And the plus Kodagraph Contact Paper brings to this is the assurance of brilliant contrast, wide latitude, flatness, long-lived legibility, and dependable uniformity.



The PLUS that Kodagraph Autopositive Paper brings to direct process and blueprinting equipment

Truly revolutionary . . . this new Kodagraph Autopositive Paper. Exposed in direct process or blueprint machines, it brings the advantages of photography to the making of masters of new tracings for highest quality prints . . . to the restoration of "unprintable" tracings, the reproduction of blueprints or opaque drawings. Does this directly—no negatives—in your present equipment, in ordinary room light.

See what this big new PLUS can mean to you—write for booklet

For unsurpassed photocopying—Kodagraph Contact Paper. For direct process and blueprinting equipment—Kodagraph Autopositive Paper. And for printing from reduced-scale negatives, there are Kodagraph Projection Papers. To survey the possibilities of this Kodagraph line—quickly—write for "The Big New Plus."

Eastman Kodak Company
Industrial Photographic Division
Rochester 4, N. Y.

FREE—Kodagraph booklet

Just mail coupon

Eastman Kodak Company
Industrial Photographic Division
Rochester 4, N. Y.

Please send me a copy of "The Big New Plus"—your booklet about the great new line of Kodak-made reproduction papers.
I have ☐ direct process ☐ blueprint ☐ contact printing equipment.

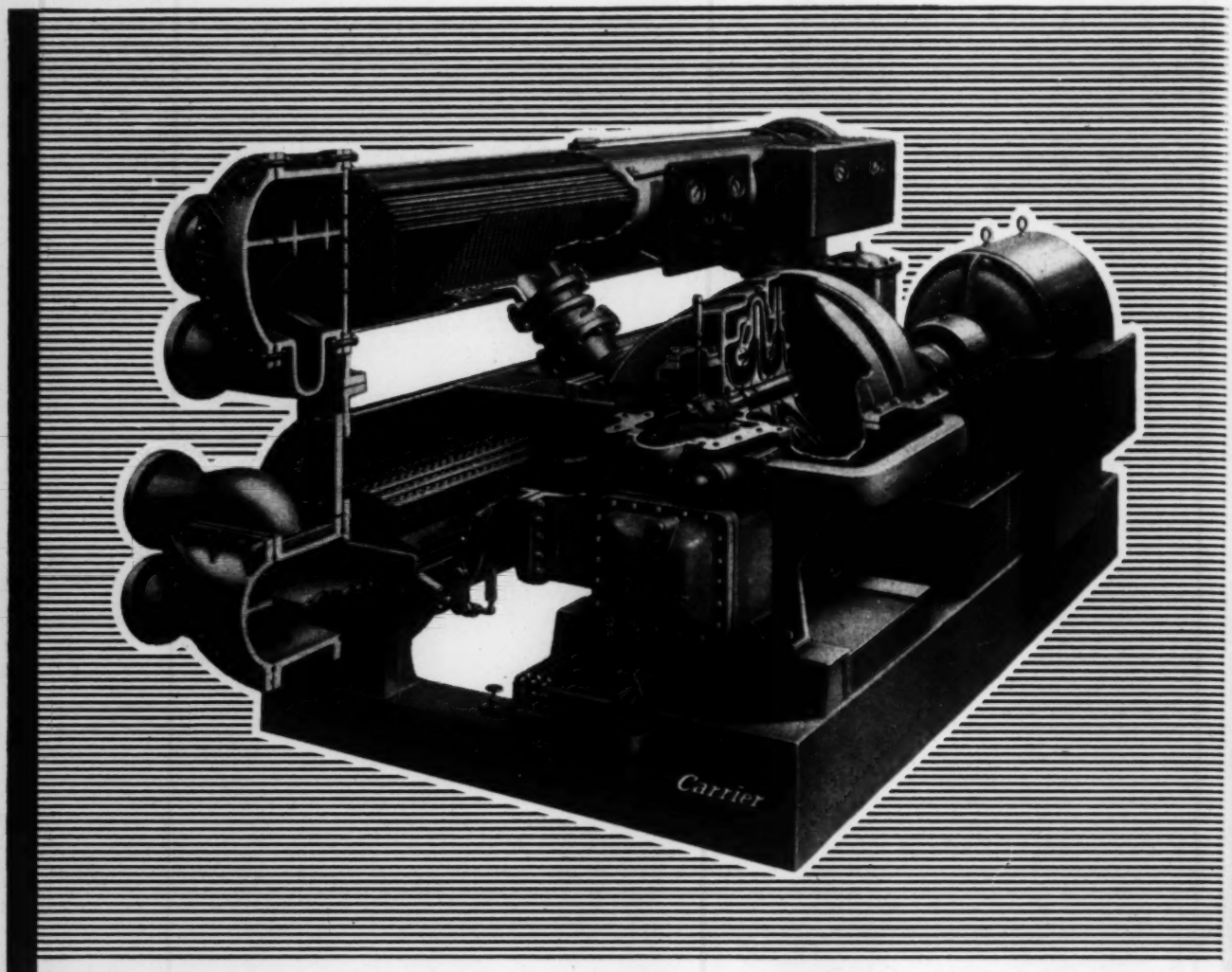
Name_____
(please print)

Department_____

Company_____

Street_____

City_____ State_____



do a bigger refrigeration job at smaller cost

Here's the story of the Carrier Centrifugal Refrigerating Machine in four words—high efficiency, low cost.

The Carrier centrifugal is backed by more than a quarter-century of successful operation in large-scale installations. It supplies low-temperature refrigeration for industrial processing and food preservation. It is the heart of the air conditioning system in many of the world's best-known buildings. In fact, *more Carrier-designed centrifugals are in use today than any other kind.*

The same Carrier skill that developed the first centrifugal refrigerating machine has led the way to every major improvement . . . "Lo-Fin" tubing to simplify maintenance and lighten weight . . . an economizer to reduce horsepower . . . and the *exclusive all-metal* Carrier shaft seal to save refrigerant and costly repairs.

Carrier Centrifugal Refrigerating Machines offer a choice of capacities from 100 to 1200 tons—for motor or direct turbine drive. They're adaptable to a variety of refrigerants and can be connected with existing ammonia systems. Carrier Corporation, Syracuse, New York.

Carrier

air conditioning

refrigeration

industrial heating

Announcing the publication starting January, 1948 of a new scientific review journal

APPLIED MECHANICS REVIEWS

A Review of Current World's Literature in Applied Mechanics

Applied Mechanics Reviews

A Critical Review of the World Literature in Applied Mechanics

L. H. Donnell, Editor — S. Timoshenko, Editorial Advisor

GENERAL

General Theoretical and Experimental Methods 00

B. MECHANICS OF SOLIDS

1. Elastic Behavior

Elasticity Theory 00
Experimental Stress Analysis 00
Stress Concentrations 00
Rods, Beams, Tubes, Cables, etc. 00
Plates, Disks, Shells, Membranes 00
Buckling Problems 00
Welds, Rivets, and Other Joints 00
Structures (General) 00
Aeronautical Structures 00

2. Nonelastic Behavior

Plastic Flow, Forming Processes 00
Laws of Failure, Cutting Processes 00
Significance of Material Tests 00
Material Test Techniques 00
Properties of Specific Materials 00
Soil Mechanics 00

3. Vibration and Waves

Vibrations, Impact, etc. (General) 00
Vibration Isolation and Measurement 00

ACOUSTICS 00
Flutter 00

Dynamics of Rigid Bodies

Kinematics, Statics, General Dynamics 00
Gyroscopics, Balancing, Governors 00

C. MECHANICS OF FLUIDS 00

Aerodynamics of Flight 00
Exterior Ballistics 00
Potential Flow 00
Turbulence, Boundary Layer, etc. 00
Compressible Flow, Gas Dynamics 00
Cavitation, Transportation of Solids 00
Lift, Drag, Transportation of Solids 00
Propellers, Fans, Turbines, etc. 00
Experimental Flow Equipment and Technique 00
Lubrication Problems 00
Hydraulics, Flow in Pipes, etc. 00
Meteorological, Dynamics, Wind Velocity, Tides 00
Marine Engineering Problems 00

D. HEAT 00

Heat Transfer 00
Thermodynamics 00

Published by The American Society of Mechanical Engineers

January, 1948 — Vol. 1, No. 1

Dr. L. H. Donnell, Editor
Dr. S. Timoshenko, Chairman of Editorial Associates

There are approximately 500 magazines serving the Applied Mechanics and allied fields but there exists no publication designed to review this literature.

APPLIED MECHANICS REVIEWS will meet this urgent need. It will cover the important theoretical and experimental papers in the fields traditionally covered by Solid Mechanics, Fluid Mechanics, Thermodynamics, and Heat Transfer, as well as applications of the subjects to Geophysics and to specialized fields such as Soil Mechanics, Acoustics, Ballistics and Lubrication. Emphasis will be given to topics of current interest.

To keep readers informed of new developments as they occur, APPLIED MECHANICS REVIEWS will scan all sources throughout the world in which interesting information might be published but will report, analyze, and review only papers presenting material which would be of significance to those who work with or use the results of research in this subject. All reviews will be written and signed by authorities in the particular fields of Mechanics involved. Each monthly issue will contain approximately 200 reviews.

APPLIED MECHANICS REVIEWS will be published by the A.S.M.E. with the support of the Engineering Foundation and the Illinois Institute of Technology. Supervision of its editorial policy will be exercised by a committee representing, besides the A.S.M.E., The Office of Naval Research, the American Institute of Physics, The American Society of Civil Engineers, the Institute of the Aeronautical Sciences, the American Mathematical Society, the Society for Experimental Stress Analysis, The Institution of Mechanical Engineers, and The Engineering Institute of Canada.

Orders should be sent to

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 W. 39 St., New York 18, N. Y.

Subscription price, $12.50 per year—special price of $9.00 per year to members of the above societies.

high ratios?

✳ ONE OF 93

DE LAVAL DOUBLE REDUCTION WORM GEARS

De Laval double reduction speed reducers, consisting of combinations of double worm gear reductions, or helical and worm gear reductions, are available with overall ratios up to approximately 8000 to 1. De Laval single reduction worm gear speed reducers are available in ratios up to 90 to 1. If high ratios are your requirement, worm gear speed reducers are the answer -- particularly if space is limited and reliability is important. A De Laval representative will help you pick the right size and type.

✳ This double reduction De Laval Worm Gear Speed Reducer is available in many standard ratio combinations, with horizontal or vertical output shafts and is but one of 93 sizes of standard De Laval Worm Gear Speed Reducers.

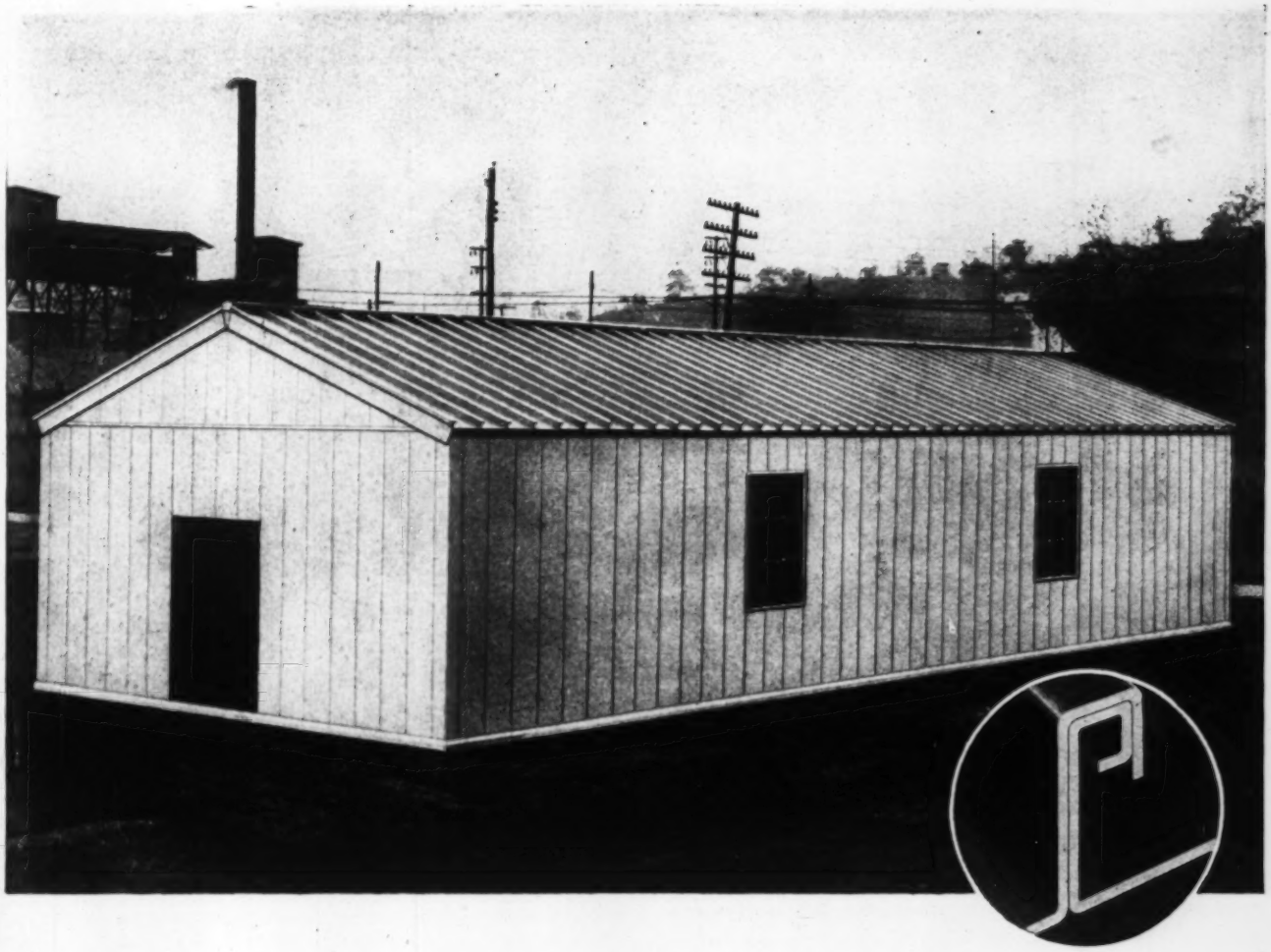
DE LAVAL

Worm Gear Division **— De Laval Steam Turbine Company, Trenton 2, N. J.**

Atlanta • Philadelphia • Charlotte • Pittsburgh • Cleveland • Rochester • Detroit • San Francisco • Chicago
New York • Denver • Kansas City • Helena • Boston • Houston • Washington, D. C. • St. Paul • Los Angeles • New Orleans • Seattle • Salt Lake City • Tulsa • Edmonton • Winnipeg • Toronto • Vancouver

WG-14

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS



Better Buildings - Prompt Delivery

Building ideas have changed—thanks to the ARMCO STEELOX Joint. Now you can have a new prefabricated building in hours instead of weeks, and it's so simple it's unique.

With the STEELOX method the jointed panels provide both structural support and finished surface. For sidewalls they save framing and outside covering. On the roof they replace rafters, sheathing and roofing. Erection is simplified, appearance improved, and weathertight construction assured. Unskilled workmen join the panels into a low-cost, maintenance-free structure.

There are other advantages too. STEELOX Buildings are made of Galvanized ARMCO PAINTGRIP Steel for immediate painting and long paint life. No pre-treatment is required. You'll also find STEELOX Buildings give you the durable service and low-upkeep of a permanent structure and yet when necessary they can be dismantled and re-erected at another location without loss of material.

STEELOX Buildings are ideal for offices, garages, utility buildings and similar structures. They are prefabricated in a wide range of standard sizes — widths from 8 to 28 feet, lengths from 8 to 200 feet and eave heights from 8 to 14 feet.

Mail the coupon for complete data. Armco Drainage & Metal Products, Inc., 4075 Curtis St., Middletown, O.

SEND ME DATA ON STANDARD *ARMCO STEELOX* BUILDINGS

Armco Drainage & Metal Products, Inc.
4075 Curtis Street, Middletown, Ohio

TYPE OF BUILDING _____

COMPANY _____

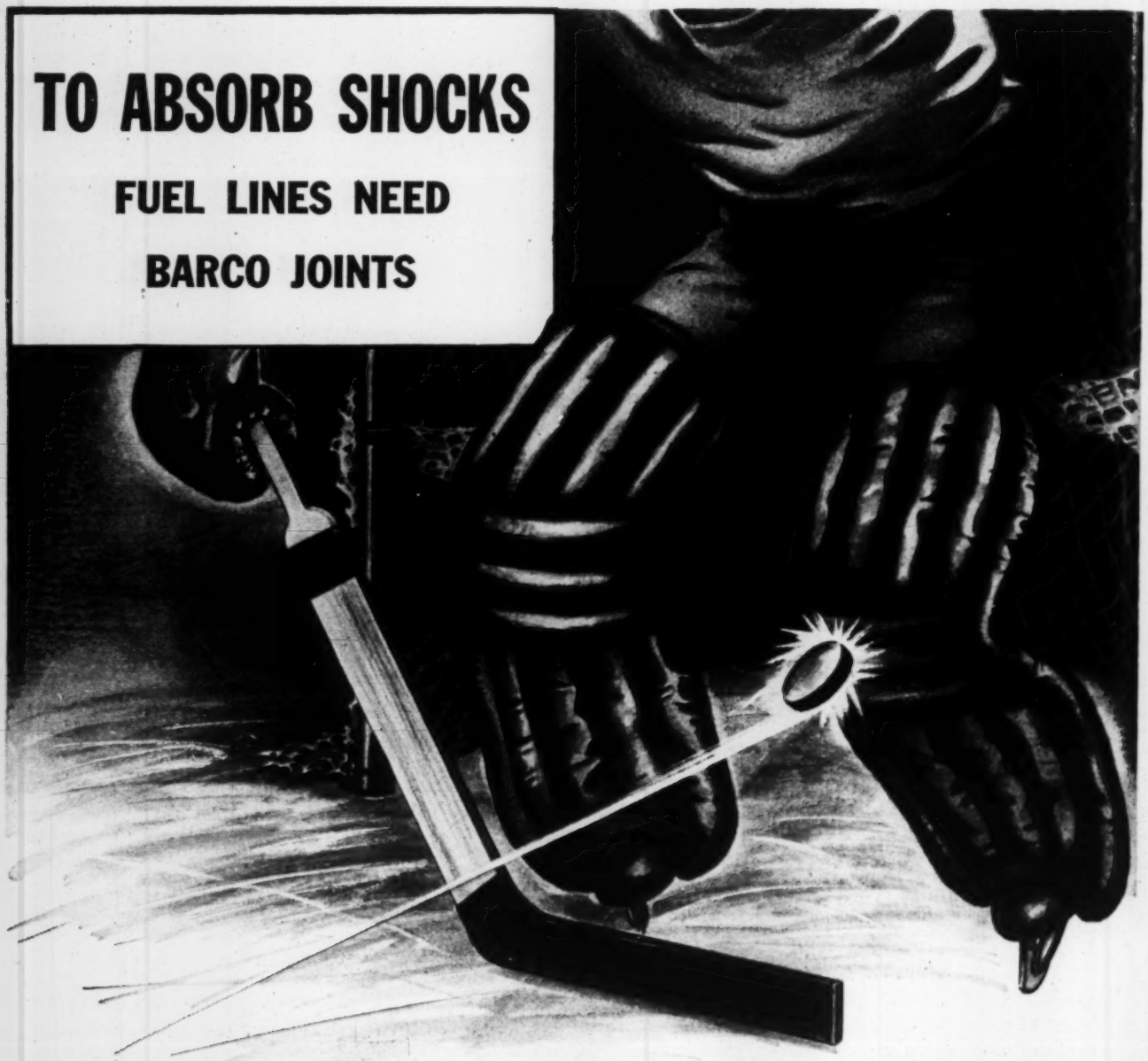
STREET _____

CITY _____ STATE _____

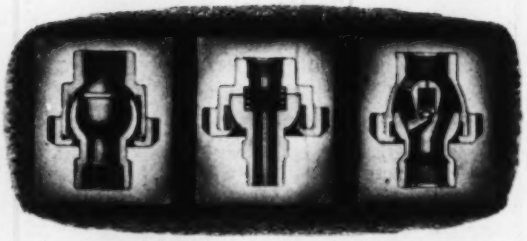
ARMCO STEELOX BUILDINGS

TO ABSORB SHOCKS

FUEL LINES NEED BARCO JOINTS



Fuel lines don't last long unless, like this hockey goalkeeper, they are protected from impact and shocks. Barco Flexible Joints, by responsive movement through every angle, absorb shocks and stresses in fuel lines, compensate for expansion and contraction. For over 30 years, these valuable time and cost savers have been guarding fluid-conveying systems from the deadly effects of vibration, preventing leakage and fractures. Whatever your special installation may be, you'll find the right joint for it in the Barco line. Write for complete facts. Barco Manufacturing Company, Not Inc., 1807 Winnemac Avenue, Chicago 40, Illinois. In Canada: The Holden Co., Ltd., Montreal, Can.



BARCO FLEXIBLE JOINTS

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

Not just a swivel joint ...but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

"MOVE IN EVERY DIRECTION"

NICE
Specialists in "Specials"
NICE Engineers are recognized for their experience and ingenuity in designing and producing ball bearings that economically meet unusual requirements. These "specials," like Nice standard bearings, can be constructed of non-corrosive materials, such as stainless steel, brass or bronze . . . with special features, such as dust shields, grease seals, extended inner races with grease fittings, etc., where applicable and when warranted by quantities involved. A few of these special bearings are shown.
#5788
#5398
#5399
#5788 — Thrust or radial type with full floating center race. End races are integral. The load is absorbed by the two extending pins on center race. Produced for tractor governors.
#5398 — Radial type bearing with square outer housing with oil holes. Square form allows ease of installation and prevents outer housing from turning. Produced for domestic washing machine wringer rolls.
#5399—Combination bearing with eccentric stud. Designed for thrust loads but capable of taking radial loads created by eccentric motion. Used for vibrating, sorting and grading machinery.
HAVE YOU ANY SPECIAL REQUIREMENTS ON WHICH WE MAY WORK?
NICE
Ball Bearings
NICE
NICE BALL BEARING CO.

"A real BOTTLENECK buster...

Flux-Injection certainly opens new fields for stainless design"

1 — The flanged periphery of the head.

2 — Adjacent inner ring, removed by Flux-Injection, cut into radial segments, and drilled, to form extractor plates.

3 — Bearing ring for rotor.

4 — Type 347 stainless vanes (Figs. 1 & 2) finish-cut by Flux-Injection and welded to nickel cladding.

5 — One-half of tub wall, separately fabricated of nickel-clad, in position for checking alignment and fit-up prior to shipping.

That's the stamp of approval placed on Airco's New Flux-Injection Method of cutting stainless, and nickel-clad steels by Smith & Caffrey Co., Syracuse, N. Y. and Dilts Machine Works (Division of Black-Clawson Co., Inc.) Fulton, N. Y.

Smith & Caffrey's problem was to manufacture a new all-welded design of the Dilts Hydrapulper, a paper making machine which reduces paper and pulp to slush form. Because of the abrasive and corrosive nature of the required mixture, the hydrapulper had to be fabricated from stainless and nickel-clad steels. Flux-Injection permitted the cutting of parts to finished dimensional accuracy, and with the utmost protection for the cladding. Resulting edges were in excellent condition for welding.

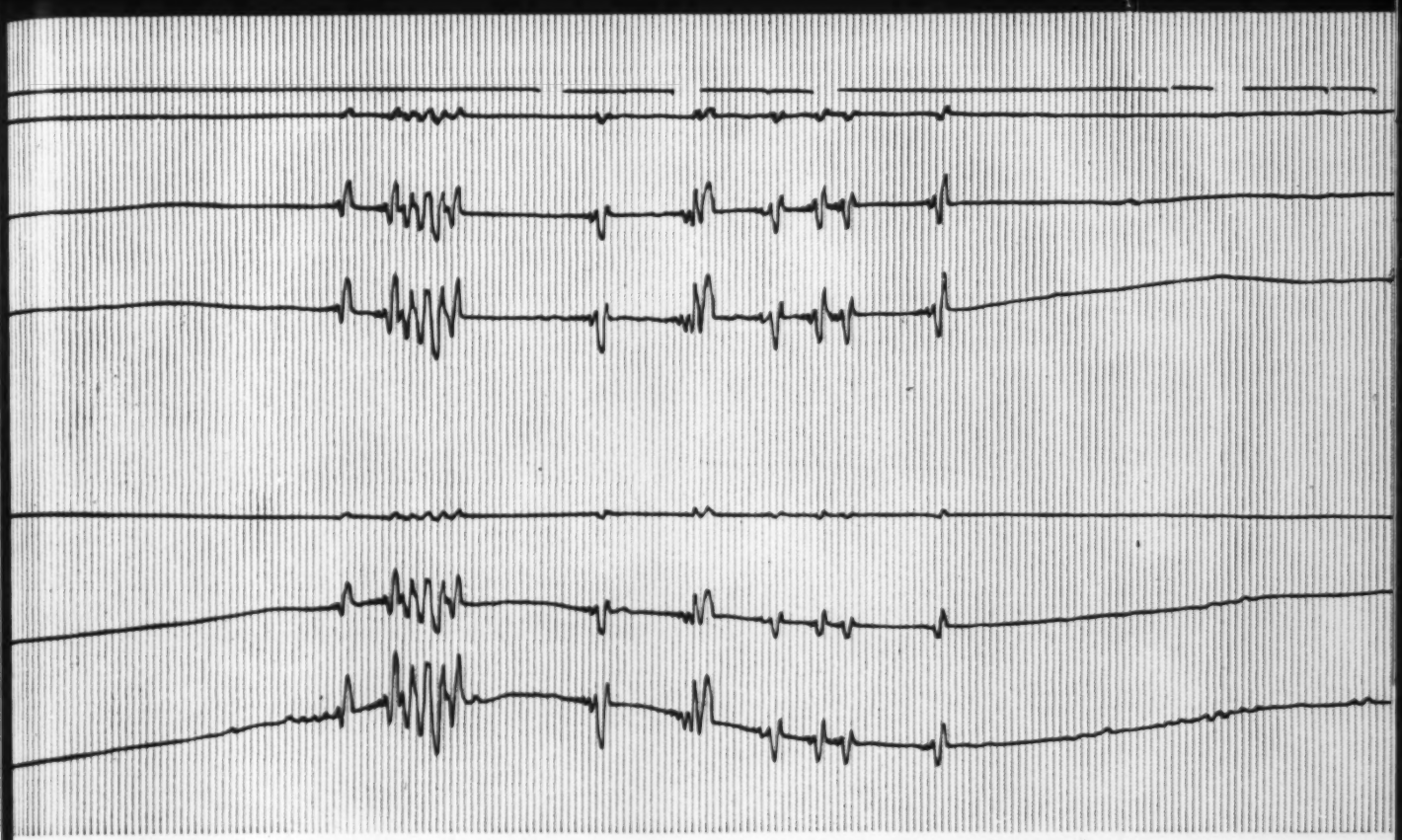
This new Flux-Injection Stainless steel cutting method was developed to enlarge the scope of standard Airco oxyacetylene cutting equipment. It keynotes simplicity, safety and economy of operation.

The factual article "Flux-Injection Method Brings Economies of Oxyacetylene Flame Cutting to Stainless Steels" gives further details. For your free copy of this interesting explanatory article, write to Dept. MEE-7288, Air Reduction, General Offices, 60 East 42nd Street, New York 17, N. Y. In Texas: Magnolia Airco Gas Products Company, General Offices, Houston 1, Texas. Internationally represented by Airco Export Corporation.

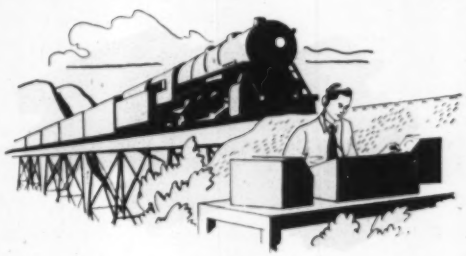
AIRCO **AIR REDUCTION**

Offices in All Principal Cities

Headquarters for Oxygen, Acetylene and other gases . . . Carbide . . . Gas Welding and Cutting Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories



Picture of a bridge groaning under load...



. . . photographic stress analysis is one of many industrial uses for light-sensitive Kodak recording materials.

By cementing strain gauges smaller than postage stamps to external surfaces, test engineers can find out about structural behavior deep inside the material under stress . . . so sensitive is the response of these little devices to vibration and strain.

An important contribution to such sensitivity in instruments of this type is the wide latitude of Kodak photographic recording materials that are available. These may be had in all sizes and speeds for nearly every type of instrument.

Instrument Recording

. . . another important function of photography

Kodak is continually developing new recording products, and is glad to discuss them with you—so your new instruments may take full advantage of the finest in photographic recording.

Why not utilize the greater sensitivity and speed of photographic recording for your instruments? Why not find out how well the new Kodak high speed recording papers will work in your equipment? Just write to

EASTMAN KODAK COMPANY
Industrial Photographic Division
Rochester 4, N. Y.

Eastman Kodak Company
Industrial Photographic Division
Rochester 4, N. Y.

☐ Please send me your book "Recording Materials."

☐ Please send information on your new high speed recording papers.

Name_____

Company_____

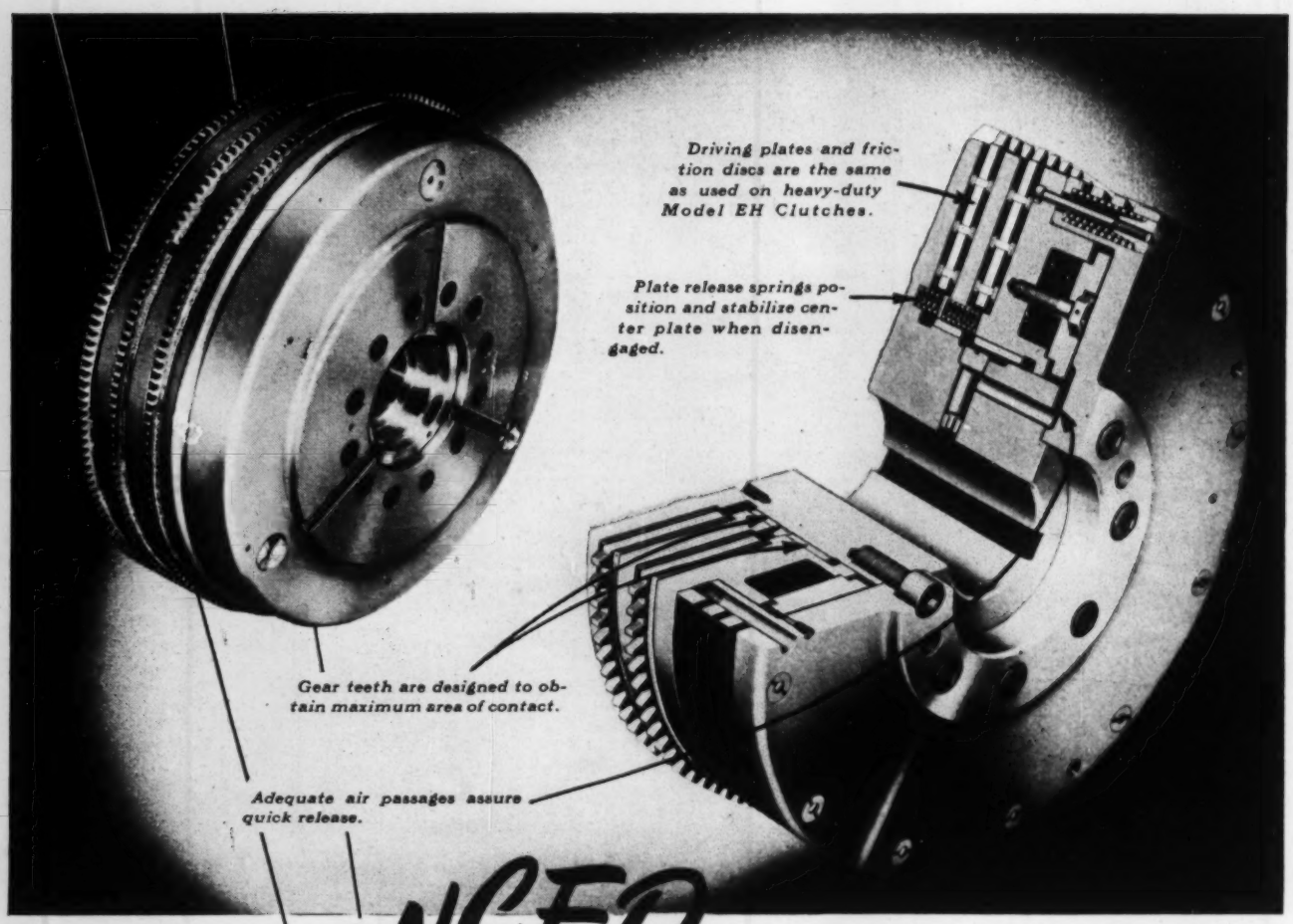
Department_____

Address_____

City_____

State _____

Kodak


Driving plates and friction discs are the same as used on heavy-duty Model EH Clutches.
Plate release springs position and stabilize center plate when disengaged.
Gear teeth are designed to obtain maximum area of contact.
Adequate air passages assure quick release.

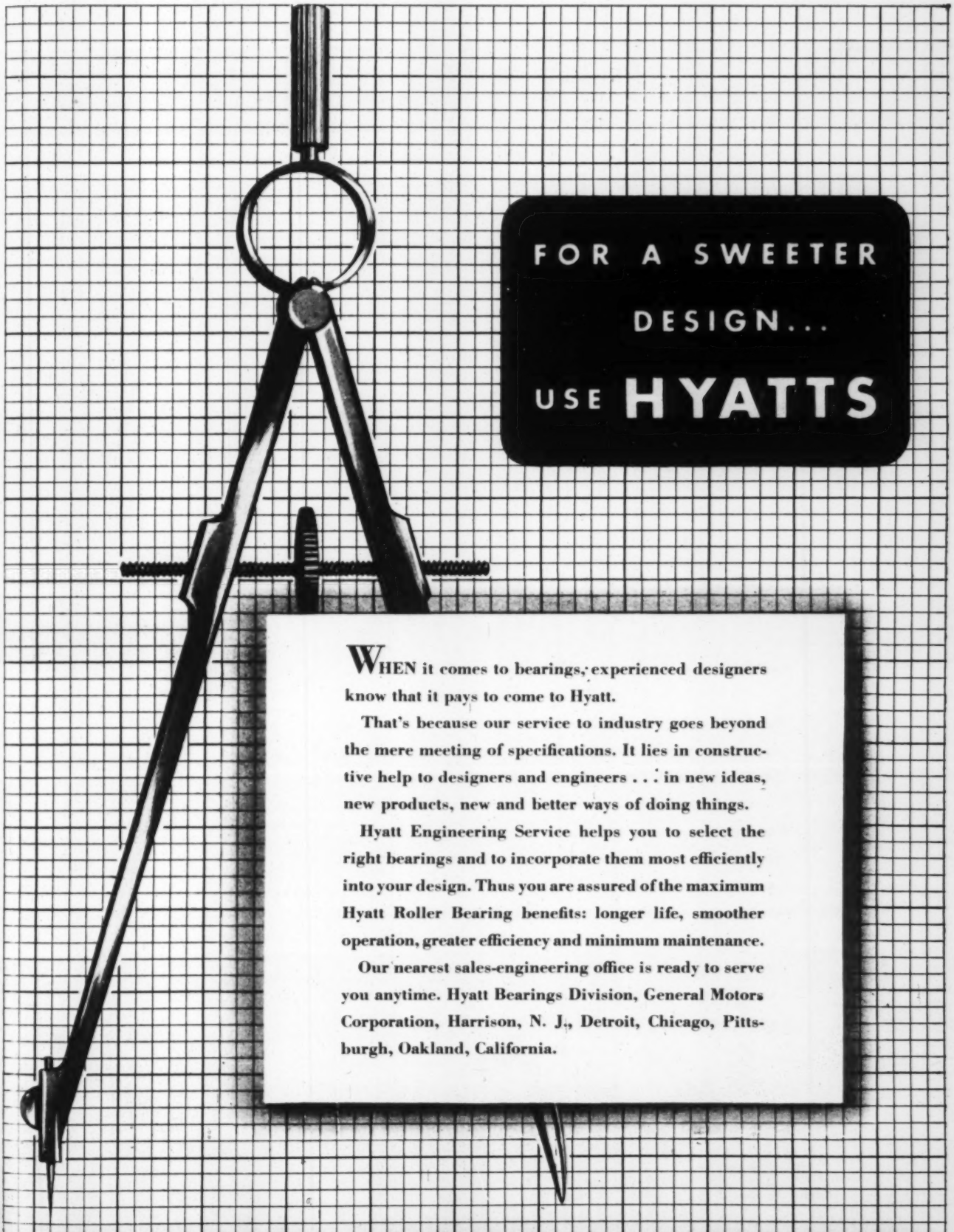
BALANCED ...for work, wear, heat

Experience has proved the mechanical proportions of the Twin Disc Models P and PH Air-actuated Clutches to be in proper balance for efficient work, for long wear-life, and to absorb and dissipate heat . . . essential qualities in heavy-duty clutch installations.

Twin Disc Air-actuated Clutches also permit operation by remote control without complicated linkage systems. They require less shaft space, thereby permitting closer shaft bearing center distances. Gear teeth are designed to obtain maximum area of contact. Multiple springs assure quick release and equal distribution of release pressure. Properly installed, these Clutches require no adjustments to maintain the correct pressure on the friction discs . . . an important factor in obtaining longer wear-life. Model P and PH Clutches are available in sizes from 14 to 42″, capacities from 75 up to 1325 hp.

If you have a heavy-duty clutch application requiring operation by remote control, write the Twin Disc Clutch Company for their engineers' recommendations. Ask for Bulletin No. 139-A. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918



FOR A SWEETER DESIGN...

USE HYATTS

WHEN it comes to bearings, experienced designers know that it pays to come to Hyatt.

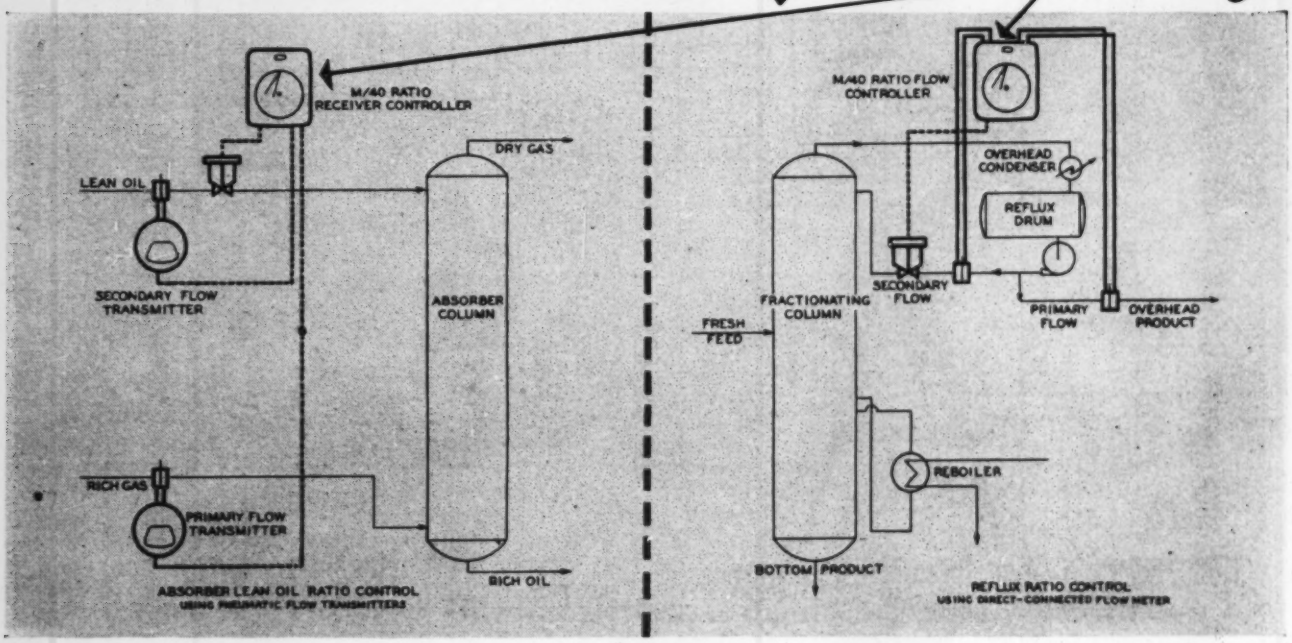
That's because our service to industry goes beyond the mere meeting of specifications. It lies in constructive help to designers and engineers . . . in new ideas, new products, new and better ways of doing things.

Hyatt Engineering Service helps you to select the right bearings and to incorporate them most efficiently into your design. Thus you are assured of the maximum Hyatt Roller Bearing benefits: longer life, smoother operation, greater efficiency and minimum maintenance.

Our nearest sales-engineering office is ready to serve you anytime. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Detroit, Chicago, Pittsburgh, Oakland, California.

HYATT ROLLER BEARINGS

KEEPING FLOW OF TWO FLUIDS IN EXACT RATIO... *Automatically*



with FOXBORO Flow-Ratio Controllers on the job

● By controlling the flow of a liquid or gas in unvarying, continuous ratio to that of another, sensitive processes like distillation and absorption can be streamlined to peak efficiency. Every change in the flow of the primary fluid is reflected by a proportional change in the secondary fluid flow, thereby maintaining a constant ratio between the two. The operation is precise, instantaneous, and completely automatic. Liquid level, pressure, and other process variables may similarly be ratio-controlled. (Controllers are also available to ratio more than one secondary flow to a common primary flow.)

The Foxboro Flow-Ratio Controller offers unique advantages both in its measuring system and in its M-40 control mechanism. Its combination of accuracy, sensitivity, flexibility, and simplicity is unrivalled.

The ratio mechanism has been specifically designed to maintain set ratios accurately through the whole range of the instrument. The desired ratio is easily obtained by turning a calibrated thumb wheel visible through the chart plate. The mechanism is a compact, rugged unit that fits into any Model 40 Controller.

Write for detailed information. **The Foxboro Company, 182 Neponset Ave., Foxboro, Mass., U.S.A.**

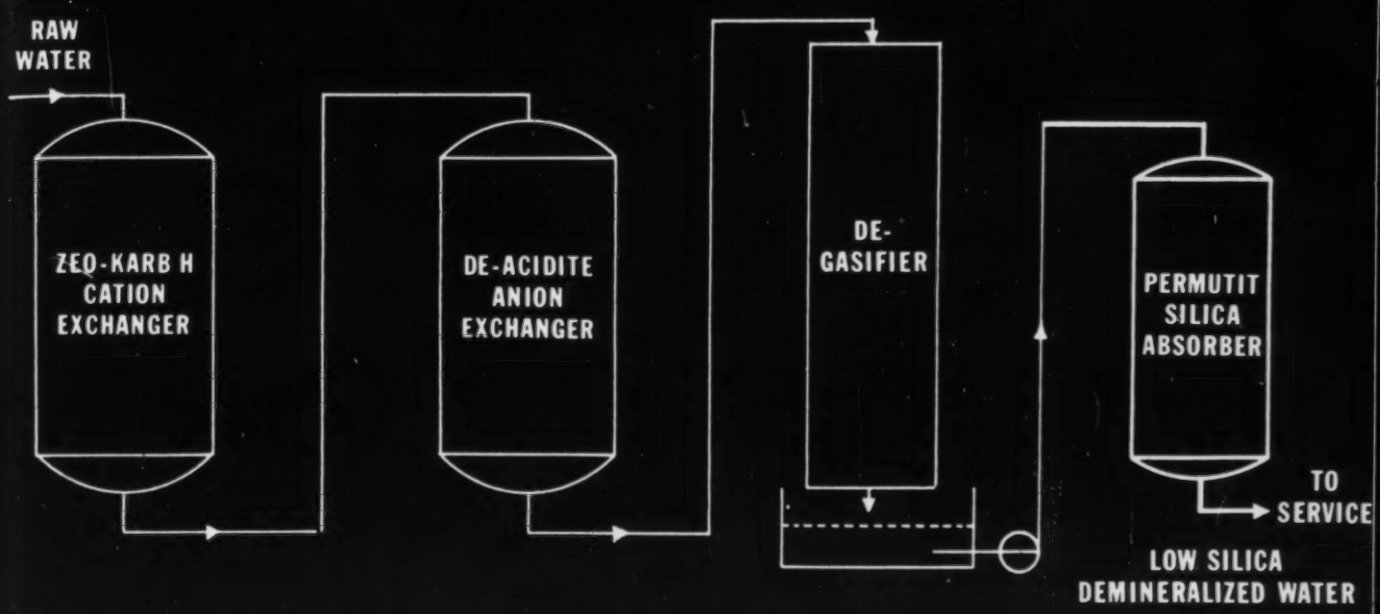
FOXBORO

M-40

CONTROLLER

Foxboro Flow-Ratio Unit installed in M-40 Controller

THE **ONLY** CONTROLLER WITH *Permaliqued* CONSTRUCTION



SILICA REMOVAL
combined with
DEMINERALIZATION!

HERE'S AN ECONOMICAL NEW CHEMICAL PROCESS FOR PRODUCING THE EQUIVALENT OF DISTILLED WATER!

The Permutit* two-step Demineralizing process utilizes Zeo-Karb H, Permutit's acid-regenerated cation exchanger to replace metallic cations with hydrogen ions, converting salts present into corresponding acids. These acids are then removed from solution by De-Acidite, Permutit's resinous anion exchanger.

Permutit has pioneered by adding to the Demineralizing process a new, one-step cold process silica removal treatment which removes silica down to less than 0.5 p.p.m.—making possible ideal, low silica, demineralized boiler-feed make up!

• • •

For information about this revolutionary new, low first cost, low operating cost treatment, address The Permutit Company, Dept. ME-12, 330 West 42nd Street, New York 18, N. Y., or the Permutit Company of Canada, Ltd., Montreal.

*Trade Mark Reg. U. S. Pat. Off.

for 34 years

Permutit

WATER CONDITIONING HEADQUARTERS

WATER CONDITIONING • ION EXCHANGERS • MATERIALS AND EQUIPMENT

Bullard Man-Au-Trol gets precision and rigidity with Timken bearings

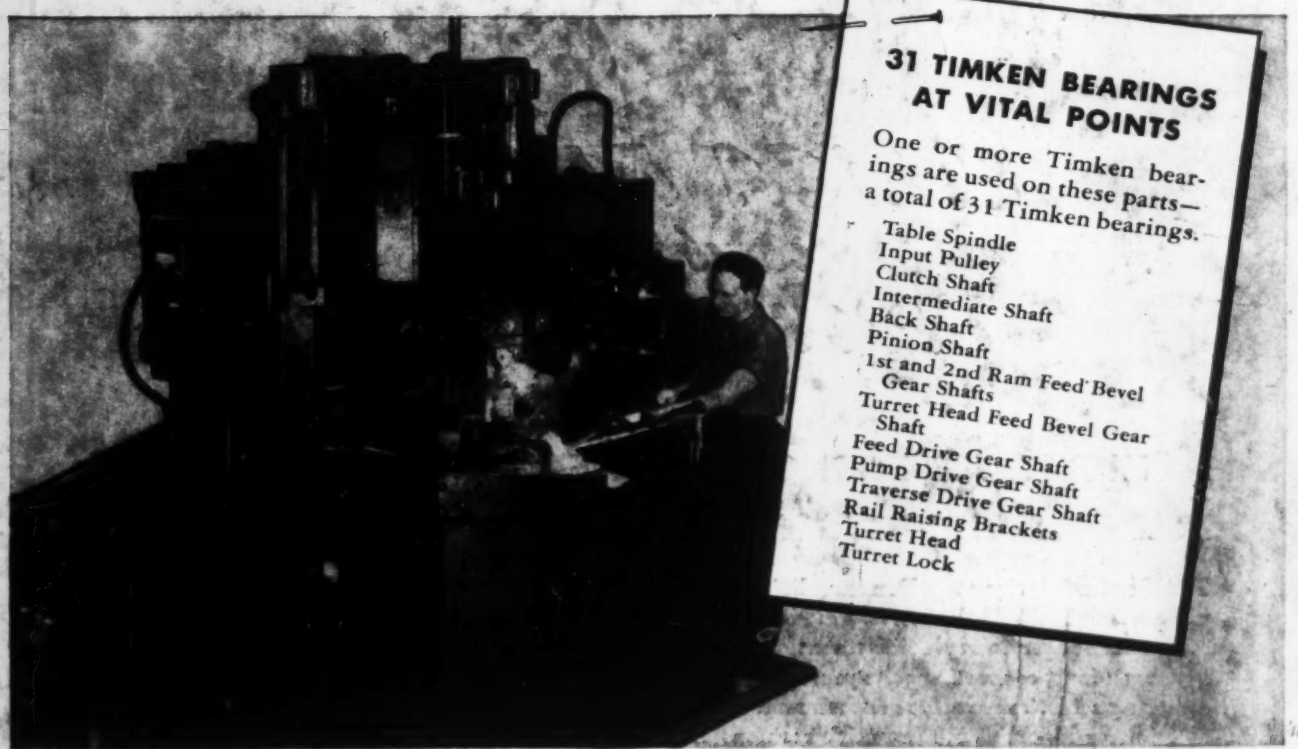
TREMENDOUSLY heavy cuts, high speed automatic operation . . . two big reasons why absolute rigidity and precision are necessary in the Bullard Man-Au-Trol Vertical Turret Lathe. How does Bullard get them? With Timken bearings.

Timken bearings on the work table and throughout the drive of this outstandingly successful machine keep gears and shafts absolutely rigid, yet free to rotate with minimum friction. Maximum support is provided by the line contact between the tapered rolls and races of the bearings. Work table precision is further insured because the Timken bearing is a "Generated Unit Assembly"—no need for breaking-in or final adjustment on the job. The Timken fine alloy steel used in Timken bearings makes the bearing normally outlast the machine itself. Due to their tapered construction, Timken bearings can be accurately pre-loaded.

Whatever type of machine tool you buy or build, it can benefit from the increased rigidity and precision Timken bearings make possible. And remember, no other bearing can give you *all* the advantages you get with Timken bearings, The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.



31 TIMKEN BEARINGS AT VITAL POINTS

One or more Timken bearings are used on these parts—a total of 31 Timken bearings.

- Table Spindle
- Input Pulley
- Clutch Shaft
- Intermediate Shaft
- Back Shaft
- Pinion Shaft
- 1st and 2nd Ram Feed Bevel Gear Shafts
- Turret Head Feed Bevel Gear Shaft
- Feed Drive Gear Shaft
- Pump Drive Gear Shaft
- Traverse Drive Gear Shaft
- Rail Raising Brackets
- Turret Head
- Turret Lock

POSITIVE ROLLER ALIGNMENT

Rollers of Timken bearings are prevented from skewing by the wide area contact between roll ends and rib of the cone . . . a Timken Roller Bearing Company development. Result: bearings roll easier, last longer.

The Timken Roller Bearing Company is the only bearing manufacturer in the country which makes its own steel, and is the acknowledged leader in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION